THE
Tutor and Scholar's Assistant;

BEING

A NEW TREATISE

OF

VULGAR AND DECIMAL ARITHMETIC:

G

CONTAINING

A LARGE COLLECTION OF

ORIGINAL QUESTIONS,

WITH

NOTES

AT THE FOOT OF THE PAGE TO EXEMPLIFY AND ILLUSTRATE THE RULES.

ANSWERS TO THE QUESTIONS

ARE PRINTED SEPARATE

BY WAY OF KEY.

By JOSEPH SAUL, Wigan,

LATE TEACHER OF THE MATHEMATICS, AT THE
REV. T. LITTLEWOOD'S ACADEMY, ROCHDALE.

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BRITISH MUSEUM

TO THE

*Rev*ᵈ. *THOMAS LITTLEWOOD*,

MASTER OF TOWN-HEAD ACADEMY,

ROCHDALE;

AND THE REST OF THE SUBSCRIBERS,

THIS TREATISE

IS,

WITH DUE GRATITUDE AND SUBMISSION,

HUMBLY INSCRIBED,

BY THEIR OBEDIENT

HUMBLE SERVANT,

THE AUTHOR.

BRITISH MUSEUM

PREFACE.

THE uſefulneſs of Arithmetic to every perſon in every occupation or ſphere in life, is ſo well known, that an attempt to reduce it to a more comprehenſive point of view, and facilitate the acquirement of a knowledge thereof will need no apology. The modelling it in ſuch a form, and adding ſuch illuſtrations and inſtructions as might render it the moſt uſeful both to teacher and ſcholar, has been the aim of the compiler of this treatiſe. The rules are conciſe, without any unneceſſary contracted methods,—the contractions are pointed out in the notes, ſo, as to give the learner an opportunity of underſtanding the reaſons from which both are derived. The number of queſtions is larger than what is commonly given in a work of this kind, and ſo varied as to prevent the ſcholar from working them mechanically. I have frequently obſerved, that boys working long ſtrings of quite ſimilar queſtions, expect to learn by habit, forbear to exerciſe any reaſon, and generally forget the preceding rules; I have therefore added promiſcuous queſtions in many places, in order to induce them to take a retroſpect of what they have already learned, or ought to have learned; the queſtions too being original ones, will prevent their ſtealing anſwers out of other books. The anſwers are printed ſeparate, in a Key, which may be kept out of the ſcholar's hands to prevent his making random trials till he meets with the anſwer, without exhibiting his miſtaken ideas to his teacher and getting the neceſſary information from him. As it cannot be expected that a boy entering upon a new rule can be able to work queſtions by directions merely, without being ſhewn how ſome of them are done, I have given an example in the notes under each rule, and variety thereof, worked at large and illuſtrated, with ſuch other directions, explanations and reaſons as may be very uſeful to the learner, if he be accuſtomed to pay attention thereto; ſo that it is hoped upon trial, this book will not be found totally unworthy of the title of both *The Tutor and Scholar's Aſſiſtant*; viz. a convenience to the one, and information for the other.

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THE TUTOR AND SCHOLAR'S ASSISTANT.

NUMERATION.

NUMERATION teaches to read and write Figures according to their value.

Every figure increaſes its value tenfold by being removed one place towards the left hand, as appears by the following

TABLE.

Tens of Thouſands, &c.	Thouſands	Hundreds	Tens	Trillions	Hundreds of Thouſands	Tens of Thouſands	Thouſands	Hundreds	Tens	Billions	Hundreds of Thouſands	Tens of Thouſands	Thouſands	Hundreds	Tens	Millions	Hundreds of Thouſands	Tens of Thouſands	Thouſands	Hundreds	Tens	Units
of Trillions					of Billions						of Millions											
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
																					6	0
										4										6	0	0
									4	7									6	0	0	0
								4	7	3								6	0	0	0	0
							4	7	3	5							6	0	0	0	0	0
						4	7	3	5	1						6	0	0	0	0	0	0
					4	7	3	5	9	1					6	0	0	0	0	0	0	0
				4	7	3	5	1	9	2				6	0	0	0	0	0	0	0	0
		4	7	3	5	1	9	2	8	6			6	0	0	0	0	0	0	0	0	0

368
417
3671
87914
80710
465319
807104
9630725
96047301
810730100
9605901010

4
40
407
4070
40701
407010
4070103
47001003
407010031
4070100318*

* * *

A Fraction is a part of ſomething expreſſed by two numbers one wrote above the other; the higher is called the Numerator, and the lower the Denominator, as $\frac{7}{8}$ is read ſeven eighths—$\frac{7}{8}$ Numerator, Denominator; viz. 7 divided by 8.

SIGNS

---

* This cannot be ſufficiently explained without a Teacher; nevertheleſs, it may not be improper to obſerve, that as many units or ones any figure expreſſes or ſtands for alone, or in the units place, ſo many tens it ſtands for in the ſecond or tens place, and ſo many hundreds in the third place, and ſo on, as in the table: alſo, every third figure is hundreds, the firſt being ſimply hundreds, the ſecond hundreds of thouſands, the third hundreds of millions, &c. and every ſixth figure after units may be conſidered as a period expreſſing millions, the firſt being millions, the ſecond millions of millions, or billions, the third millions of millions of millions, or trillions, &c. a number conſiſting of many figures may be pointed into periods of three or ſix figures.

The cipher or o has no value, and therefore is only uſed to ſupply the place where no value is expreſſed and remove the others to places where they will denote the value deſired;—ſo 396 is read three hundreds and ninety-ſix, and 30906 is read thirty thouſands nine hundreds and ſix.

SIGNS AND CHARACTERS.

+ ſignifies added to, as $6+4$ is 6 added to 4.
− ſignifies ſubtraction, as $6-4$ is 4 taken from 6.
× ſign of multiplication, as 6×4 is 6 multiplied by 4.
÷ divided by, as $24\div 4$ is 24 divided by 4.
= equal to, as $6+4=10$ is 6 added to 4 is equal to 10.
: : ſign of proportionality.

◆

SIMPLE ADDITION.

ADDITION is the putting numbers together.

The ſum or total is what any ſet of numbers make when put together.

RULE*.

Write units under units, tens under tens, &c. begin at the units column, add all the figures therein together, write down the units figure of the ſum, and carry the tens to the next column; which add in the ſame manner, place down the units figure of the ſum, and carry the tens as before; thus do with every column, and write down the whole ſum at the laſt, and your work will be finiſhed.

---

* EXAMPLE.—Add 746, 485, 973, 46 and 85 together.

```
746
485
973
 46
 85
----
2335
----
```

Write the numbers as in the margin, units under units, &c. ſay 5 and 6 make 11, and 3 make 14, and 5 make 19, and 6 make 25; write down 5 and carry 2 to 8 make 10, and 4 make 14, and 7 make 21, and 8 make 29, and 4 make 33; write down 3 and carry 3 to 9 make 12, and 4 make 16, and 7 make 23, which write down and the ſum is 2335 as in the work.

The reaſon for carrying the tens figure will be evident by conſidering that its value cannot be expreſſed without removing it beyond the units figure, as will appear by writing both down.

Examples.

1.	2.	3.	4.
237	3678	35978	473876
468	5281	64735	958293
593	7539	28674	847598
218	6284	93625	695724
746	9376	64738	328695
593	4267	67536	873569

5.	6.	7.	8.
468	4267	64738	328695
218	6284	28674	847598
593	5281	35978	473876
237	9376	67536	873569
746	7539	93625	695724
593	3678	64735	958293
738	2573	28967	367251
695	9816	56371	632748

9.—Add 5678, 9123, 4567, 8912, 3456, 7891, 2345, 6789, 1234 and 7358 together.

10.—Add 67891, 23456, 78912, 34567, 89123, 45678, 91234, 56789, 12345 and 75369 together.

11.—Add 738926, 549167, 389265, 491673, 892654, 916738, 926549, 167389, 265491 and 673892 together.

12.—Add 2734506, 7265493, 2406351, 7593648, 4280715, 5719284, 8173062, 1826937, 372948 and 43785 together.

13.—Add 372, 901, 468, 593, 729, 14, 685, 937, 290, 146, 859 and 648 together.

14.—What is the ſum of 5768, 9123, 4567, 8912, 3456, 7891. 2345, 6789, 1234, 7360, 2753 and 2715?

15.—Add 34567, 89123, 45678, 91234, 56789, 12345, 67891, 23456, 78912, 36257, 49368 and 73629 together.

16.—What is the ſum of 372419, 627580, 342087, 657912, 162039, 837960, 740536, 259463, 135274, 864725, 731584 and 42586?

17.—Add 123, 345, 567, 789, 234, 456, 678, 912, 891, 216, 783, 309, 690 and 128 together.

18.—Add 3728, 1495, 6372, 8149, 5637, 2814, 9563, 7281, 4956, 2309, 7690, 9063, 936 and 87 together.

19.—Add 72814, 95637, 28149, 56372, 81495, 63728, 14956, 37281, 49563, 23785, 76214, 99738, 261 and 428 together.

20.—Add 372814, 728149, 563728, 149563, 728149, 281495, 814956, 495637, 956372, 637281, 271850, 947318, 52681 and 742638 together.

21.—What is the ſum of 313, 726, 217, 879, 870, 10, 310, 354, 397, 823, 645, 243, 573, 721, 306 and 28?

22.—Add 3728, 1964, 5372, 8196, 4537, 2819, 6453, 7281, 9645, 5469, 1827, 3546, 9182, 7354, 6918 and 2735 together.

23.—Add 15263, 74891, 52637, 48915, 26374, 89152, 63748, 91526, 37489, 26374 85912, 63748, 59126, 37485, 91263 and 74859 together.

24.—Add 517826, 361474, 383711, 972238, 79643, 36216, 271236, 83453, 359214, 23748, 642231, 423548, 35601, 575787, 945873 and 56930 together.

25.—Add 5634185, 622877, 2730599, 3241521, 785632, 28776, 4726, 2938, 10027, 89591, 528, 217328, 3526, 52884, 3135 and 838259 together.

26.—Add 81211300, 4372154, 3684725, 5148721, 71465349, 21977442, 40925972, 3428147, 2384145, 492615, 43264510, 83276143, 2551578, 15929372, 787271, 4214233 and 724361 together.

27.—Add 72413604, 43214716, 51486721, 2374848, 7723837, 1472651, 43125274, 34575291, 152789, 58374619, 47861521, 37254913, 2316733, 6423158, 5124176, 36231432, 4943561 and 61679287 together.

28.—Add 32834577, 58374619, 47861521, 13412751, 23371241, 37254913, 2316733, 3742142, 92805739, 32467521, 6423158, 5124176, 36231432, 8104627, 32185962, 9236428, 4943561 and 61679287 together.

29.—Add 3284123, 354819, 897782, 954286, 47414876, 5014458, 43159, 46371, 807142, 711254, 50170998, 8174325, 23589, 25518823, 385061, 721314, 83892421 and 2786574 together.

30.—What is the ſum of 357804117, 489763132, 716421273, 653914871, 827689143, 836173281, 271234626, 325272319, 658349271, 396285148, 714968204, 523867143, 819358478, 312757869, 284198174, 453621898, 531917829, 747980355, 617283490, 14270809?

SIMPLE SUBTRACTION.

SUBTRACTION is the taking one number from another, by which we find their difference, or how much the greater exceeds the leſs.

The difference, or what is left after ſubtracting, is called the remainder.

RULE*.

Write the leſs number below the greater, units under units, tens under tens, &c. Take every lower figure from the higher, beginning at the units' place; where the higher figure is too little add 10 to it, and for every 10 ſo added to the higher figure, add 1 to the next lower figure.

To

---

* EXAMPLE.—Subtract 2743 from 14285.

14285
2743
———
11542
———
14285
———

Write the numbers as in the margin, the leſs number below the greater; that is, the number to be ſubtracted under that which is to be ſubtracted from; and units under units, tens under tens, &c. ſay 3 from 5 and 2 remains, 4 from 8 and 4 remains, 7 from 2 I cannot, ſo I borrow 10 to 2 makes 12, then 7 from 12 and 5 remains, and for the 10 I borrowed I put 1 to 2 makes 3, and 3 from 4 and 1 remains, then 0 from 1 and 1 remains, ſo the whole remainder or difference is 11542, which added to 2743 the leſs number, makes 14285 the greater, which proves the work.

Ciphers

To prove the work, add the two loweſt numbers together, that is, the leſſer number and remainder, the ſum will be the greater.

EXAMPLES.

1. From 37284506
Take 15928734

2. From 104735264038
Subtract 67359846736

3.—Subtract 9472863 from 140592641.
4.—From 2307936584 ſubtract 98736537.
5.—Take 693752867 from 3147253678.
6.—From 35970462814 take 973842675.
7.—What is the difference between 35968 and 52873?
8.—What is the difference between 4902735 and 837596?
9.—How much does 3729568 exceed 1982873?
10.—How much is 428379604 leſs than 1047256781?
11.—Take 37946259738 from 1004728569362.
12.—If 372609346 be ſubtracted from 427350864 what will remain?
13.—What is the difference between 637928564 and 635768006?
14.—What is the difference between 173000640 and 4800037400?
15.—What number muſt be added to 360758 that the ſum may be 628563?
16.—The ſum of two numbers is 462583 and one of them is 239468, what is the other?

17.—How

Ciphers having no value in the laſt places may be omitted, for 0039 is but 39.

If at the laſt place you have occaſion to borrow, you are ſubtracting the greater number from the leſs, which cannot be done.

To diſtinguiſh readily which of two numbers is the greater, you may obſerve that, that which has the more figures is greater, and if they have an equal number, that which has the greateſt left hand figure, or the greateſt neareſt the left hand, is the greater.

The difference of two numbers added to the leſs will make the greater; or ſubtracted from the greater will leave the leſs.

One of two numbers ſubtracted from their ſum will leave the other.

17.—How much muſt be added to 342785 to make 673941 for the ſum?

18.—What number muſt be ſubtracted from 3709568 to leave 693784 for the Remainder?

19.—How long is it ſince the Year 1629?

20.—What was the Year of our Lord 139 Years ago?

21.—A Bond dated in the Year 1695; how old is it?

22.—In what year was that perſon born who is now 56 years old?

23.—Borrowed £. 567 and paid again £. 395, how much remains unpaid?

SIMPLE MULTIPLICATION.

MULTIPLICATION is the finding how much any number amounts to when repeated any given number of times; and this is done by the help of the following

TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

The Multiplicand is the number to be multiplied.

The Multiplier is the number to multiply by.

Both the Multiplicand and Multiplier are called Factors.

The Product, or Rectangle, is the number produced by multiplying.

RULE*.

Multiply the units figure of the multiplicand, write down the units figure of the product and reſerve the tens; then multiply the ſecond figure of the multiplicand, to the product add the number reſerved; write down the units figure of the ſum, and reſerve the tens

to

---

* EXAMPLE.—Multiply 864 by 7.

$$\begin{array}{r} 864\\ 7\\ \hline 6048\\ \hline \end{array}$$

Write the Multiplier under the Multiplicand, as in the Example, ſay 7 times 4 is 28, write down 8 and carry 2, then 7 times 6 is 42 and 2 that I carry make 44, write down 4 and carry 4, then 7 times 8 is 56 and 4 that I carry make 60, which write down and the product is 6048.

$$\begin{array}{r} 287\\ 143\\ \hline 861\\ 1148\\ 287\\ \hline 41041\\ \hline \end{array}$$

When there are ſeveral figures in the multiplier, as in the annexed example, firſt multiply by the units figure thereof as before, then by the ſecond figure in like manner, writing the firſt figure of its product in the ſecond place, then by the third figure, writing the firſt figure of its product in the third, then the ſum of theſe particular products added as they ſtand is the product required.

$$\begin{array}{r} 428\\ 600\\ \hline 256800\\ \hline \end{array}$$

If there be ciphers before the multiplier, put as many ciphers before its product, and take care that the firſt figure of each product ſtand as far from the units place as the figure you multiply by, then you cannot err but in multiplying, for the figures of the multiplier may be taken in any order.

$$\begin{array}{r} 2864\\ 13040\\ \hline 114560\\ 85920\\ 2864\\ \hline 37346560\\ \hline \end{array}$$

to be added to the next product as before; thus do with every figure of the multiplicand, and write down the whole ſum at the laſt place.

EXAMPLES.

1. Multiply 372819645 Multiply 372819654
By 2 By 3

2.—Multiply 738475296 by 2, 3, 4, 5, 6, 7, 8 and by 9.
3.—Multiply 1234567890 by 1, 2, 3, 4, 5, 6, 7, 8, and by 9.
4.—Multiply 1426938507 by 2, 3, 4, 5, 6, 7, 8, 9, and 10.

When the multiplier conſiſts of ſeveral figures, multiply by each ſeparately, and place the products under one another, ſo, that the firſt figure of each product may ſtand as far from the units place as the figure of the multiplier

---

To multiply by two figures in one line, when one of them is unity,

Multiply 273
By 17
4641
273
71
19383

to the product of every figure of the multiplicand add the right hand figure thereof beſides the number you carry; but if unity ſtand on the right hand, add the left hand figure of the multiplicand to each product; thus you may contract two lines into one, when one of them is procured by multiplying by one, which will be beſt underſtood by conſidering the work at large, and obſerving in what order they ſtand to be added. In the ſame manner you may add the two next figures, when there are two units in the multiplier adjoining the figure you multiply by.

To multiply by any number of 9s, you may annex as many ciphers to the multiplicand and ſubtract the original multiplicand from the number, the remainder will be the product required.

234 by 99
23400
234
23166

For annexing two ciphers is multiplying by 100, from which take 1, the remainder is 99, ſo once the multiplicand taken from 100 times the ſame leaves 99 times.

Hence

multiplier which produces it; add them in that poſition, and the ſum will be the product required.

EXAMPLES.

5. Multiply	379185246	Multiply	379185246
By	23	By	45

6.—Multiply 715296384 by 67, 89, 321, 476, and by 893.

7.—Multiply 37592684 by 476, 2531, 7468, and by 3459.

8.—Multiply 716258349 by 7849, 3526, and by 2164.

9.—Multiply 478369725 by 37952, 67405, and by 718409.

10.—Multiply 128037906 by 4708605, and by 390064080

11.—Multiply

Hence to multiply by any number of 3s, work as for 9s, and one third of the reſult will be the product required.

To multiply firſt by one number, and that product by another, is the ſame as to multiply by the product of thoſe multipliers, for 7 times 6 times is 42 times; this will be beſt underſtood by working examples both ways.

Shillings multiplied by 12 will reduce them to pence, becauſe 1 ſhilling is 12 pence; therefore any number of ſhillings will be 12 times ſo many pence.

734	5
246	3
4404	6
2936	
1468	
180564	6

The true proof to multiplication is diviſion, but a preſumptive proof is by caſting out the 9s, as follows—Add all the figures together in the multiplicand, caſting away the 9s as the ſum amounts to that number; thus, 7 and 3 is 10, from which leave 9 there remains 1, then 1 and 4 is 5, which put down; the ſame do with the multiplier, and there remains 3, theſe two remainders multiplied together and the nines taken out of the product there remains 6; then add the product in the ſame manner, the remainder being 6 as before, I preſume the work is true.

Queſtions will always prove by the foregoing method when they are true, and ſometimes when they are not.

11.—Multiply 786036970 by 781041600, and by 69700060500.
12.—Multiply 39067400700 by 6973006000 and by 428003900.
13.—Multiply 37586492 by 13, 17. 41, 81, and by 19.
14.—Multiply 3679285 by 15, 18, 11, 14, 71, and by 31.
15.—Multiply 56732968 by 117, 611, 181, 119, and by 151.
16.—Multiply 37291846 by 99, 999, 990, and by 909.
17.—Multiply 3040500602 by 40410002, and by 120098030007.
18.—How many pence are in 746 ſhillings?
19.—Multiply 346 by twenty-ſeven.
20.—How many pounds are 746 hundred weights?
21.—How many days are in forty-eight years, 365 days making one year?

If you can take two or more ſuch numbers, that their product will be the multiplier, and multiply by one of them, and that product by another, and ſo on; the laſt product will be the ſame as if you had multiplied by the original multiplier.

EXAMPLES.

22.—Multiply 37489 by 24, 28, 36, 49, and by 63.
23.—Multiply 72468 by 48, 108, 504, and by 512.

SIMPLE DIVISION.

DIVISION is the finding how oft one number is contained in another.

The Dividend is the number to be divided.

The Diviſor is the number to divide by.

The Quotient is the number obtained by dividing, and is the number of times which the Diviſor is contained in the Dividend.

The Remainder is a part of the Dividend which is ſometimes left after the operation.

RULE.

RULE*.

Note the feweſt left hand figures of the dividend which will contain the diviſor, aſk how oft the diviſor is contained therein, write the anſwer in the quotient, and multiply the diviſor thereby; write the product under the ſaid diſtinguiſhed part of the dividend, and ſubtract it therefrom; to the remainder annex the next figure of the dividend, then aſk how oft the diviſor is contained in that number, as before; thus proceed till you have done all the figures of the dividend—what is then left is called the remainder.

To prove your work, multiply the quotient and diviſor one by the other, and to the product add the remainder; the ſum will be the dividend if your work be true.

Diviſor. Dividend. Quotient.
1. 7) 462873 (4) 697358(
2.—Divide 73692785 by 2, 3, 4, 5, 6, and by 7.
3.—Divide 279365784 by 8, 9, 3, 4, 5, and by 6.
4.—Divide 392876459 by 2, 7, 8, 9, and by 10.

---

* EXAMPLE.—Divide 2673 by 7.

Diviſor. Dividend. Quotient.

```
 7) 2673 (381
    21      7
    ——    ——
     57   2673 Proof
     56   ——
     ——
      13
       7
      ——
       6
```

Write the diviſor and dividend as in the example; and becauſe 26 are the feweſt figures which contain 7 the diviſor, ſay, how oft 7 in 26? anſwer, 3 times, write 3 in the quotient; then 3 times 7 is 21, write 21 under 26 and ſubtract, to the remainder 5 annex 7 the next figure of the dividend, which makes 57; how oft 7 in 57? anſwer, 8 times, write 8 in the quotient; then 8 times 7 is 56, which written under 57 and ſubtracted, leaves 1, to which annex 3 the next figure of the dividend, makes 13; how oft 7 in 13? anſwer, 1, write one in the quotient; then once 7 is 7, which written under 13 leaves 6 for the remainder, and the quotient is 381, which multiplied by 7 the diviſor, and the remainder 6 added to the product makes 2673 the dividend, which proves the work.

5.—Divide 463725638 by 3, 7, 4, 6, 2, 9, 5, 8, 10, 11, and by 12.

6.—Divide 246375096 by 24, 36, 42, 54, and by 68.

7.—Divide 742869730 by 84, 95, 78, 49, and by 178.

8.—Divide 328967142 by 63, 38, 59, 84, and by 69.

9.—Divide 128374268 by 124, 238, 349, and by 672.

10.—Divide 7362597004 by 924, 296, 789, and by 374.

11.—Divide 462735968 by 1284, 2387, 6749, and by 7846.

12.—Divide 37428674593 by 38479, 72846, and by 37495.

13.—Divide 743287369470 by 87025, 67438, and by 473659.

14.—Divide 28073584697 by 492867, 736970, and by 740286.

15.—Divide 730628749365 by 473625, 674800, and by 374280.

16.—Divide 37428674300494 by 3876925, 3742086, and by 4736975.

17.—Divide 4730987362593758 by 47096204, and by 37906207.

18.—Divide 140730586400007000 by 39480760 and by 87364200.

```
674)28734(42
    2696
    ----
     1774
     1348
     ----
      426
```

In order to diſcover how oft one number is contained in another, ſee how oft the left hand figure of the one is contained in the left hand figure of the other, and conſider the increaſe that will ariſe by carrying: as how oft 674 in 2873; here I ſee how oft 6 in 28, the anſwer is 4 times 6 is 24; and I find there will be but 2 to carry makes 26, which is not too much.

Take care, that when you have multiplied, the product be not more than the number it is to be ſubtracted from, for if it is, the quotient figure is too great, and you cannot ſubtract.

If the remainder after ſubtracting be as much or more than the diviſor the quotient figure is too little.

Sometimes when the next figure of the dividend is annexed to the remainder it will not contain the diviſor, in ſuch caſe write a cipher in the quotient, and annex another figure; for you muſt put a figure in the quotient for every figure you take of the dividend, after you have written the firſt figure

19.—Divide 197284369700380400 by 893746282, and by 374290867.

When your diviſor does not exceed the number 12 you may keep the work in memory, and only place down the quotient figures; this is called ſhort diviſion.

EXAMPLES.

20.—Divide 73846975 by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.

21.—Divide 3742675967 by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.

If there be ciphers on the right hand of ſuch diviſor, you may cut them off, and as many figures from the right hand of the dividend; then divide as if both were wanting; only the figures which were cut from the dividend muſt be annexed to the remainder for the whole remainder complete.

C 2 EXAMPLES.

Short diviſion is exactly the ſame with long diviſion, but that you write down only the quotient figures; thus, how oft 7 in 37? anſwer, 5 times, which write down; then 5 times 7 is 35, which taken from 37 leaves 2, to which take 4 makes 24; how oft 7 in 24? anſwer, 3 times; then 3 times 7 is 21, which taken from 24 leaves 3 for the remainder.

$$\begin{array}{r} 7)374 \\ \hline 53\frac{3}{7} \\ \hline \end{array}$$

Here becauſe the two right hand figures are ciphers, I cut them off and two figures from the dividend, then divide 274 by 4, the quotient is 68, and 2 remains, to which annex 36 makes 236 for the whole remainder. The reaſon of this method will appear by comparing it with the work at large.

$$\begin{array}{r} 4{,}00)274{,}36 \\ \hline 68\frac{236}{400} \end{array}$$

Divide 4952 by 210, or by 7, 5, and 6, becauſe the product of 7, 5, and 6 is 210; divide by each, and you have the ſame quotient as if you divided by 210 itſelf at once.

To bring all the remainders into one—Multiply 3 the laſt remainder by 5 the diviſor preceding makes 15, to which add 2 the next preceding remainder makes 17, which multiplied by 7 makes 119, to which add 3 the preceding remainder, the ſum is 122; this may be proved by working the common method.

$$\begin{array}{rr} 7)4952 & 3 \\ \cline{1-1} & 5 \\ 5)707\frac{3}{7} & \cline{2-2} \\ \cline{1-1} & 15 \\ 6)141\frac{2}{5} & 2 \\ \cline{1-1} & \cline{2-2} \\ 23\frac{3}{6} & 17 \\ & 7 \\ 23\frac{122}{210} & \cline{2-2} \\ & 122 \end{array}$$

A Fraction

EXAMPLES.

22.—Divide 724086743 by 10, 20, 30, 40, 50, 60, 70, 80, and by 90.

23.—Divide 3273647956 by 100, 120, 300, 110, 400, 700, and by 800.

24.—Divide 487362973642 by 70, 600, 1200, 9000, and by 12000.

If you can find two or more ſuch numbers that their product will be the diviſor, you may divide by one of them, and that quotient by another, &c. the laſt quotient will be the ſame as if you had divided by the original diviſor.

To value the remainders, multiply the laſt remainder by the diviſor before its own, to the product add the remainder which that diviſor gave; then multiply the ſum by the diviſor next preceding, and add its remainder to the product, and ſo on; the laſt ſum will be the whole remainder as if you had divided by the original diviſor.

EXAMPLES.

25.—Divide 3748697364 by 24, 36, 48, 56, and by 72.

26.—Divide 2374628736 by 25, 42, 280, 81, and by 360.

27.—Divide 3479384625 by 1200, 5600, and by 320.

28.—Divide 6734286693 by 126, 378, 576, and by 189.

To multiply by a Fraction—Multiply by the numerator and divide the product by the denominator.

29.—Multiply

A Fraction is a part of any thing, expreſſed by two numbers one written above the other with a ſmall line drawn betwixt, as $\frac{3}{4}$; the lower number is called the denominator, and the higher the numerator; and the value is underſtood to be the numerator divided by the denominator, as $\left.\frac{7\ \text{Numerator}}{8\ \text{Denominator}}\right\}$ is 7 eighths, or 7 divided by 8.

EXAMPLE.—Multiply 247 by $\frac{5}{6}$.

$$\begin{array}{r} 247 \\ \frac{5}{6} \\ \hline 6)1235 \\ 205\frac{5}{6} \end{array}$$

Multiply by 5 the numerator and divide the product by 6 the denominator, the quotient $205\frac{5}{6}$ is the product required.

EXAMPLE.

EXAMPLE.

29.—Multiply 3648 by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{7}{8}$, $\frac{1}{4}$, $\frac{5}{6}$, $\frac{5}{9}$, $\frac{1}{8}$, $\frac{7}{12}$, and by $\frac{3}{16}$.

To multiply by a whole number and a fraction—Multiply by the fraction, and then by the whole number, writing the product directly under the former, add them, and the ſum will be the product required.

EXAMPLE.

30.—Multiply 327 by $3\frac{1}{4}$, $5\frac{1}{2}$, $6\frac{7}{8}$, $24\frac{3}{5}$, $48\frac{7}{8}$, and by $1\frac{5}{9}$.

To divide by a Fraction—Multiply by the denominator and divide the product by the numerator.

EXAMPLE.

31.—Divide 47689 by $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{4}$, $\frac{7}{8}$, $\frac{8}{9}$, $\frac{1}{8}$, $\frac{7}{12}$, and by $\frac{3}{16}$.

EXAMPLE Multiply 282 by $7\frac{3}{4}$.

282
$7\frac{3}{4}$
4)846
$211\frac{2}{4}$
1974
Prod. 2185

Multiply by $\frac{3}{4}$ as in the laſt, then by 7, writing the product directly under the former, then the ſum 2185 is the product required.

EXAMPLE.—Divide 248 by $\frac{3}{4}$.

$\frac{3}{4}$)248
3)992
$330\frac{2}{3}$

Multiply by 4 the denominator and divide by 3 the numerator, the quotient is $330\frac{2}{3}$.

EXAMPLE.—Divide 247 by $6\frac{2}{3}$.

$6\frac{2}{3}$ 247
— 3
20 741
$37\frac{1}{20}$

Multiply 6 by 3 the denominator, and add 2 the numerator to the product, the ſum is 20 for the new diviſor; then multiply 247 the dividend by 3 alſo for the new dividend, which divided by 20, gives $37\frac{1}{20}$ for the quotient.

The reaſon for the above method will be diſcovered, by conſidering, that if both diviſor and dividend be multiplied or divided by one and the ſame number, their quotients will ſtill be the ſame; for 3 times 4 is contained in 3 times 12 as oft as 4 is contained in 12.

The product of two numbers divided by one of them will give the other, &c.

To divide by a whole number and a fraction—Multiply the whole number in the diviſor by the denominator of the fraction, to the product add the numerator for a new diviſor: multiply the dividend alſo by the ſame number for a new dividend; divide and the quotient will be that required.

EXAMPLE.

32.—Divide 14768 by $2\frac{1}{2}$, $5\frac{1}{2}$, $7\frac{3}{4}$, $8\frac{5}{6}$, $17\frac{5}{9}$, $26\frac{2}{3}$, and by $30\frac{7}{12}$.

PROMISCUOUS QUESTIONS.

1.—Add 3746, 248, 93, 6274, 84, 298, and 87 together.
2.—What is the ſum of 79 and 84?
3.—What is the difference between 168 and 723?
4.—What is the product of 284 and 39?
5.—What is the quotient of 3864 by 83?
6.—Required the ſum, difference, product and quotient of 1824 and 76.
7.—What number muſt be added to 37846 that the ſum may be 120970?
8.—What number muſt I ſubtract 32046 from to leave 17248 for the remainder?
9.—How much is 278 times 346?
10.—What is the forty-eighth part of 4032?
11.—If a man travel 32 miles every day, how many miles will he travel in 365 days?
12.—If a man travel 960 miles in 30 days, how many miles does he travel per day?
13.—If a man owe to one perſon 246 pounds, to another 86, to another 127, to another 34, and to another 83, how much does he owe in all?
14.—What number muſt be divided by 76 to give 48 in the quotient?

15.—What number muſt be multiplied by 36 to give 1512 for the product?

16.—What muſt I divide 3024 by to give 36 in the quotient?

17.—What muſt I multiply 72 by to give 6048 in the product?

TABLES
OF
Weights and Measures, &c.

MONEY.

4 Farthings	make	1 Penny	*d.*
12 Pence		1 Shilling	*s.*
20 Shillings		1 Pound	*£.*
5 Shillings		1 Crown	*C.*
6 Shillings and 8 pence		1 Noble	*N.*
13 Shillings and 4 pence		1 Mark	*M.*
10 Shillings		1 Angel	*A.*
21 Shillings		1 Guinea	*G.*

TROY WEIGHT.

24 Grains	make	1 Penny Weight	*dwt.*
20 Penny Weights		1 Ounce	*oz.*
12 Ounces		1 Pound	*lb.*

AVOIRDUPOISE WEIGHT.

16 Drams	make	1 Ounce	*oz.*
16 Ounces		1 Pound	*lb.*
14 Pounds		1 Stone	*St.*
28 Pounds		1 Quarter	*Qr.*
4 Quarters		1 Hundred Weight	*Cwt.*
20 Hundred Weight		1 Ton	*T.*

APOTHECARIES WEIGHT.

20 Grains	make	1 Scruple	*Sc.*
3 Scruples		1 Dram	*Dr.*
8 Drams		1 Ounce	*Oz.*
12 Ounces		1 Pound	*lb.*

CLOTH MEASURE.

4 Nails	make	1 Quarter	*Qr.*
3 Quarters		1 Ell Flemiſh	*E. F.*
4 Quarters		1 Yard	*Yd.*
5 Quarters		1 Ell Engliſh	*E.E.*
6 Quarters		1 Ell French	*E. Fr.*

LONG MEASURE.

3 Barley Corns	make	1 Inch	*In.*
12 Inches		1 Foot	*Ft.*
3 Feet		1 Yard	*Yd.*
5½ Yards		1 Pole or Perch	*P.*
40 Poles		1 Furlong	*Fur.*
8 Furlongs		1 Mile	*Mile.*
3 Miles		1 League	*Lea.*
20 Leagues		1 Degree	*Deg.*
69½ Miles		1 Degree on the Globe.	

SQUARE MEASURE.

144 Inches	make	1 Foot	*Ft.*
9 Feet		1 Yard	*Yd.*
30¼ Yards		1 Pole or Perch	*P.*
40 Perches		1 Rood	*Rd.*
4 Roods		1 Acre	*Acr.*

WINE MEASURE.

2 Pints	make	1 Quart	*Qt.*
4 Quarts		1 Gallon	*Gal.*
10 Gallons		1 Anker	*Ank.*
18 Gallons		1 Rundlet	*Rlt.*
42 Gallons		1 Tierce	*Tier.*
63 Gallons		1 Hogſhead	*Hhd.*
84 Gallons		1 Puncheon	*Pun.*
2 Hogſheads		1 Pipe	*P.*
4 Hogſheads, or		1 Tun	*T.*
18 Cwt.		1 Tun of Wine	*T.W.*

ALE AND BEER MEASURE.

2 Pints	make	1 Quart	*Qt.*
4 Quarts		1 Gallon	*Gal.*
8 Gallons		1 Firkin of Ale	*Fir. A.*
9 Gallons		1 Firkin of Beer	*Fir. B.*
2 Firkins		1 Kilderkin	*Kil.*
2 Kilderkins		1 Barrel	*Bar.*
3 Kilderkins		1 Hogſhead	*Hhd.*
2 Hogſheads		1 Butt	*Butt.*

DRY MEASURE.

2 Pints	make	1 Quart	*Qt.*
2 Quarts		1 Pottle	*Pot.*
2 Pottles		1 Gallon	*Gal.*
2 Gallons		1 Peck	*Pec.*
4 Pecks		1 Buſhel Land	*Bu. L.*
5 Pecks		1 Buſhel Water	*Bu. W.*
4 Buſhels		1 Coomb	*Coom.*
2 Coombs		1 Quarter	*Qr.*
4 Quarters		1 Chaldron	*Chal.*
5 Quarters		1 Ton or Wey	*Wey.*
2 Weys		1 Laſt	*Laſt.*

TIME.

TIME.

60 Seconds	make	1 Minute	*M.*
60 Minutes		1 Hour	*Hr.*
24 Hours		1 Day	*Day.*
7 Days		1 Week	*Wk.*
4 Weeks		1 Month	*Mo.*
13 Months and 1 Day		1 Year	*Yr.*

Twelve calendar months make a year—of which September, April, June, and November, have each 30 days; February has 28, and in Leap Year 29; all the reſt have 31 days each.

REDUCTION.

BY Reduction we change money, weights, meaſures, &c. out of one denomination into another, without altering the value or quantity.

To reduce greater denominations into leſs—Multiply by the number of that name which you would reduce them into, that makes one of the name you have to reduce.

To reduce leſs denominations into greater—Divide by as many of that name you would reduce as make one of the name you would reduce them into.

You may reduce firſt to one name and then to another, till the name required be obtained *.

Examples.

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* Example.—Reduce 47l. 16s. to ſhillings.

£.47 16 Becauſe one pound contains 20 ſhillings, it is evident
20 that any number of pounds are twenty times that
—— number of ſhillings;—the given ſhillings muſt be
S. 956 added to the product.

Example.—Reduce 956 ſhillings to pounds.

20)956 Becauſe there are 20 ſhillings in one pound, as oft as
—— there are 20 in a given number of ſhillings ſo many
£. 47 16*s.* pounds there are—the remainder is ſhillings.

Examples.

EXAMPLES.

1.—Reduce 247 pounds into ſhillings.
2.—Reduce 468 Shillings into pence.
3.—Reduce 273 pence into farthings.
4.—Reduce 47l. 13s. 4d. into farthings.
5.—Reduce 47864 farthings into pence.
6.—Reduce 27468 pence into ſhillings.
7.—Reduce 47864 ſhillings into pounds.
8.—Reduce 74l. 16s. 7d. into pence.
9.—Reduce 47389675 farthings into pounds.
10.—In 476 cwt. how many quarters and pounds?
11.—In 368 gallons how many quarts?
12.—In 420 feet how many inches?
13.—Reduce 37468 lbs. into hundred weights.
14.—Reduce 3729 feet into yards.
15.—In 4768 crowns how many pounds?
16.—In 7368 poles how many yards?
17.—Reduce 3746 guineas into pounds.
18.—Reduce 7963 pounds into guineas.
19.—Reduce 14 tons, 9 cwt. 3 qrs. into ounces.
20.—Reduce 76947285 ounces to hundred weights.
21.—Reduce 14 years, 7 months, and 2 weeks to hours.

22.—Reduce

EXAMPLE.—Reduce £.7 4s. 8d. to farthings.

£.7 4s. 8d.
20
——
144 *s.*
12
——
1736 *d.*
4
——
6944 *qr.*

It is often neceſſary to reduce firſt to one name and then to another, as pounds to ſhillings, thoſe ſhillings to pence, and thoſe pence to farthings, adding always to each product the given number of the ſame name.

EXAMPLE.—Reduce 6944 farthings to pounds.

4)6944 *qr.*
——
12)1736 *d.*
——
20) 144 8*d.*
£.7 4*s.* 8*d.*

So farthings may firſt be reduced to pence, thoſe pence to ſhillings, and thoſe ſhillings to pounds—each remainder is of the ſame name with the dividend out of which it is left.

When

22.—Reduce 473628 grains, apothecaries weight, to pounds.
23.—Reduce 76lb. 7oz. 16 dwts. and 10grs. into grains.
24.—Reduce 47 acres, 3 roods and 27 perches to perches.
25.—Reduce 473628 perches into acres.
26.—Reduce 372536 inches to miles.
27.—Reduce 4 miles, 3 furlongs, 14 poles, and 2 yards to yards.
28.—Reduce 16 years, 5 months, and 2 weeks to minutes.
29.—Reduce 17 yds. 2 qrs. 1 nail to nails.
30.—Reduce 7468 marks to pounds.
31.—Reduce 47368 nobles to crowns.
32.—Reduce 1724628 pints of wine to pipes.
33.—Reduce 14 hhds, 17 gallons, and 2 quarts to pints.
34.—Reduce 374284 quarts of beer to hogſheads.
35.—In 46 ſquare feet how many ſquare inches.
36.—In 468 ſquare feet how many ſquare yards!
37.—In 72468573 minutes how many years?
38.—In 3746285736 minutes how many degrees?
39.—In 46 Engliſh ells 2 quarters how many nails?

40.—In

When you multiply it is to reduce to a leſs name, and is therefore called reduction deſcending.

When you divide it is to reduce to a greater name, and is called Reduction aſcending.

Some queſtions require both kinds; as guineas may firſt be reduced to ſhillings, and thoſe ſhillings to pounds.

Marks muſt firſt be reduced to pence, then thoſe pence may be reduced to ſhillings and pounds.

All the tables of weights and meaſures may be reduced to the following form, which would be no improper exerciſe for the learner.

Farthings			
4	1 Penny		
48	12	1 Shilling.	
960	240	20	1 Pound

*** ½ joined to pence is half a penny.
¼ do one farthing.
¾ do three farthings.

40.—In 4736284 nails how many French ells?

41.—Reduce 47684 quarts of ale to barrels.

42.—Reduce 374628 miles to degrees.

43.—Reduce 49lb. 7oz. 3 drams, 2 ſcruples, and 14 grs. into grains.

44.—Reduce 37426785 grains, apothecaries weight, to pounds.

45.—Reduce 7428643 farthings to moidores.

46.—How many inches will meaſure round the earth, which is 360 degrees, allowing 69½ miles to a degree?

47.—Reduce 4l. 15s. 4d. into farthings.

48.—Reduce 7460 guineas into pounds.

49.—Reduce 374 guineas to nobles.

50.—Reduce 24lb. 4oz. 17dwt. 12gr. into grains.

51.—Reduce 3742876 drams to hundred weights.

52.—Reduce 7lb. 6oz. 4 drams, 1 ſcruple, 14gr. to grains.

53.—Reduce 473625 perches into acres.

54.—Reduce 43756 ells Flemiſh into yards.

55.—Reduce 32 leagues, 1 mile, 3 furlongs, 2 poles to yards.

56.—Reduce 17 tierces and 2 pints of wine to pints.

57.—Reduce 3742658 pints of ale to barrels.

58.—Reduce 17 chaldrons 6 buſhels of corn to quarts.

59.—Reduce 365 days to years.

60.—Reduce 47856 crowns to guineas.

61.—Reduce 473286734 grains to pounds Troy.

62.—Reduce 23cwt. 3qrs. and 7oz. to drams.

63.—Reduce 30 acres, 2 roods and 17 perches to perches.

64.—Reduce 27yds. 3qrs. and 2 nails to nails.

65.—Reduce 173428967346 tenths of an inch to miles.

66.—Reduce 3746285 pints of brandy to hogſheads.

67.—Reduce 174 barrels and 2 quarts of ale to pints.

68.—Reduce 390426 gallons of oats to chaldrons.

69.—Reduce 1763 yrs. 7 months and 2 weeks to minutes.

70.—How many minutes is it ſince the birth of Chriſt?

COMPOUND ADDITION.

TO add compound quantities, ſuch as money, weights, meaſures, &c.

RULE*.

Firſt add the leaſt denomination, and reduce the ſum to the next greater, write down the remainder and carry the number obtained by reduction to the next column; then add as before, reduce the ſum again to the next greater denomination, write down the remainder, and carry the number obtained by reduction to the next column; thus do with every column, only the laſt or greateſt name may be added as integers.

EXAMPLES.

1.			2.			3.		
l.	*s.*	*d.*	*l.*	*s.*	*d.*	*cwt.*	*qr.*	*lb.*
273	17	7	48	19	9½	46	2	21
468	9	9	27	10	7	27	3	17
725	12	10	36	9	11¼	36	0	22
963	16	8	47	7	8	47	1	19
478	14	4	28	11	6¾	28	2	14
295	8	11	75	8	10¼	36	3	20

4.—Add

---

* EXAMPLE.—Add 27*l.* 16*s.* 8½., 14*l.* 19*s.* 7¾*d.*, 6*l.* 12*s.* 10½*d.*, and 3*l.* 8*s.* 3¼*d.* together.

	£.	*s.*	*d.*
	27	16	8½
	14	19	7¾
	6	12	10¼
	3	8	3¼
Sum.	£52	17	5¾

Write every number under thoſe of the ſame denomination, or value, as puonds under pounds, ſhillings under ſhillings, &c. as in the example; then add the leaſt denomination, or right hand column, which here are farthings; and becauſe the next column is pence, reduce the ſum to pence, write down the remaining farthings, carry the pence to the

4.—Add 34*l.* 10*s.* 10½*d.*, 27*l.* 7*s.* 7¾*d.*, 84*l.* 11*s.* 11*d.*, 93*l.* 8*s.* 8½*d.*, 67*l.* 9*s.* 9*d.*, 28*l.* 16*s.* 6*d*¼., 76*l.* 19*s.* 4*d.*, 89*l.* 12*s.* 10¾*d.*, 93*l.* 18*s.* 7*d.*, and 67*l.* 9*s.* 11½*d.* together.

5.—Add 173*l.* 19*s.* 8½*d.*, 765*l.* 10*s.* 10*d.*, 973*l.* 7*s.* 7¼*d.* 367*l.* 11*s.* 11*d.*, 284*l.* 6*s.* 9¾*d.*, 378*l.* 8*s.* 10*d.*, 259*l.* 14*s.* 6½*d.*, 675*l.* 7*s.* 8*d.*, 736*l.* 9*s.* 10^{3}*d.*, and 286*l.* 13*s.* 11½*d.* together.

6.—Add 47*yds.* 3*qrs.* 2 *nails.*, 8*yds.* 1*qrs.* 3*n.*, 16*y.* 2*q.* 0*n.*, 50*y.* 2*qr.*, 5*y.* 1*qr.* 3*n.*, 110*y.* 2*qr.* 3*n.*, 6*y.* 1*qr.* 1*n.*, 17*y.* 1*qr.* 2*n.*, and 18*y.* 3*qr.* 3*n.* together.

7.—Add 273*l.* 13*s.* 4*d.*, 127*l.* 15*s.* 10½*d.*, 168*l.* 7*s.* 7*d.* 68*l.* 10*s.* 7¼*d.*, 194*l.* 9*s.* 10*d.*, 47*l.* 9*s.* 10*d.*, 73*l.* 14*s.* 6*d.*, 93*l.* 11*s.* 9¾*d.*, 86*l.* 12*s.* 4*d.*, 64*l.* 14*s.* 6½*d.* 47*l.* 18*s.* 11*d.*, and 108*l.* 16*s.* 11½*d.* together.

8.—Add 127*l.* 17*s.* 9½*d.*, 68*l.* 15*s.* 10½*d.*, 68*l.* 8*s.* 3¾*d.*, 73*l.* 10*s.* 7¼., 47*l.* 10*s.* 8½*d.*, 69*l.* 9*s.* 10*d.*, 93*l.* 12*s.* 10¼., 78*l.* 11*s.* 9¾*d.*, 64*l.* 9*s.* 11½*d.*, 45*l.* 14*s.* 6½., 108*l.* 15*s.* 0¾*d.*, and 19*l.* 16*s.* 11¼*d.* together.

9.—Add 27*cwt.* 3*qrs.* 17*lb.* 9*oz.*, 36*c.* 2*q.* 10*lb.* 10*oz.*, 48*c.* 1*qr.* 20*lb.* 7*oz.*, 75*c.* 0*qr.* 18*lb.* 11.*oz*, 96*c.* 2*qr.* 12*lb.* 8*oz.*, 48*c.* 3*qr.* 14*lb.* 9*oz.*, 36*c.* 0*qr.* 16*lb.* 13*oz.*, and 29*c.* 1*qr.* 22*lb.* 12*oz.*, together.

10.—Add 348*yds.* 3*qrs.* 1 *nail*, 125*yds.* 2*qr.* 2*n.*, 94*yds.* 1*qr.* 3*n.*, 68*yds.* 3*qr.* 0*n.*, 217*yds.* 0*qr.* 1*n.*, 36*yds.* 2*qr.* 2*n.*, 48*yds.* 1*qr.* 3*n.*, and 15*yds.* 3*qr.* 1*n.*, together.

11.—Add 17*lb.* 10*oz.* 17*dwt.* 21*gr.*, 26*lb.* 7*oz.* 16*dwt.* 10*gr.*, 47*lb.* 6*oz.* 13*dwt.* 16*gr.*, 18*lb.* 9*oz.* 12*dwt.* 20*gr.*, 36*lb.* 11*oz.* 15*dwt.* 21*gr.*, 91*lb.* 8*oz.* 8*dwt.*

12*gr.*,

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the pence column, add the pence, reduce the ſum to ſhillings, write down the remaining pence, and carry the ſhillings to the ſhillings column, which add, and reduce the ſum to pounds, write down the remaining ſhillings, and carry the pounds to the pounds column, and pounds being the greateſt name want no reduction, and therefore may be added as whole numbers—here the ſum is 52*l.* 17*s.* 5¾*d.*

So

12*gr*., 24*lb*. 4*oz*. 12*dwt*. 13*gr*., and 8*lb*. 9*oz*. 17*dwt*. 15*gr*., together.

12.—Add 247*l*. 16*s*. 8*d*., 94*l*. 13*s*: 4½*d*., 19*l*. 13*s*. 10¼*d*., 7*l*. 15*s*. 11¼*d*., 23*l*. 10*s*. 8¾*d*., 127*l*. 19*s*. 5¾*d*., 84*l*. 16*s*. 7½*d*., 130*l*. 00*s*. 11½*d*,, 63*l*. 10*s*. 4¾*d*., 8*l*. 18*s*. 8*d*., 19*l*. 19*s*. 9¼*d*., 37*l*. 13*s*. 3*d*., 72*l*. 12*s*., 34*l*. 9*s*. 8¾*d*., 3*l*. 15*s*. 6*d*., 30*l*. 9*s*. 10½*d*., 28*l*. 17*s*. 4¾*d*., 100*l*. 14*s*: 7*d*., and 16*l*. 6*s*. 8½*d*., together.

13.—Add 147*l*. 13*s*. 4*d*., 28*l*. 13*s*. 7½*d*., 164*l*. 7*s*. 11½*d*., 96*l*. 3*s*. 8*d*., 0*l*. 16*s*. 11½*d*., 19*l*. 4*s*. 7¾., 48*l*. 3*s*. 10½*d*., 130*l*. 13*s*. 11¾*d*., 67*l*. 16*s*. 8½*d*., 43*l*. 13*s*. 7*d*., 106*l*. 13*s*. 10½*d*., 100*l*. 19*s*. 7¼*d*., 34*l*. 6*s*. 8¾*d*. 34*l*. 18*s*. 8*d*., 3*l*. 9*s*. 1½*d*., 31*l*. 6*s*. 9*d*., 37*l*. 13*s*. 4*d*¾., 28*l*. 11*s*. 10½*d*., 15*l*. 14*s*. 5½*d*., 48*l*. 17*s*. 9¾*d*., 19*l*. 11*s*. 7*d*. 24*l*. 13*s*. 4*d*., 14*l*. 3*s*. 6½*d*., and 7*l*. 19*s*. 10¼*d*. together.

14.—What is the Sum of 4*l*. 16*s*. 7*d*., 14*l*. 1*s*. 10¾*d*., 22*l*. 17*s*. 11¼*d*., 27*l*. 19*s*. 6¼*d*., 1*l*. 6*s*. 4½*d*., 41*l*. 6*s*. 5½*d*., 14*l*. 11*s*. 6*d*., 65*l*. 17*s*. 0¾*d*., 58*l*. 6*s*. 0¾*d*., 17*l*. 2*s*. 11½*d*., 2*l*. 10*s*. 10¼*d*., 47*l*. 0*s*. 6*d*., 76*l* 13*s*. 4*d*., and 9*l*. 14*s*. 11*d*.?

15.—What is the Sum of 3*l*. 17*s*. 10½*d*., 4*l*. 0*s*. 4*d*., 0*l*. 19*s*. 10½*d*., 1*l*. 7*s*. 6½*d*., 2*l*. 13*s*. 8¾*d*., 14*l*. 7*s*. 11*d*., 3*l*. 13*s*. 9½*d*., 0*l*. 18*s*. 5¾*d*., 4*l*. 13*s*. 7¾*d*., 7*l*. 16*s*. 8¾*d*., 3*l*. 19*s*. 8½., 2*l* 10*s*. 10*d*., 2*l*. 15*s*. 11½*d*., 4*l*. 13*s*. 11*d*., 1*l*. 15*s*. 9¼*d*., 2*l*. 17*s*. 8¾*d*. 5*l*. 19*s*. 3½*d*., 7*l*. 11*s*. 0*d*., 10*l*. 9*s*. 6¾*d*., 4*l*. 13*s*. 8½*d*., 3*l*. 13*s*. 7½*d*., 4*l*. 16*s*. 4½*d*. 5*l*. 16*s*. 11*d*., and 0*l*. 16*s*. 8½*d*.

16.—Add

So hundred weights, quarters, and pounds muſt be added, reducing the pounds to quarters, and quarters to hundred weights, the hundred weights, if they are not to be reduced to a greater name, muſt be written down in the ſame manner as whole numbers.

Theſe conſiderations may be applied to any other denominations.

Numbers of different denominations cannot be added, for four ſhillings and three-pence will not make ſeven ſhillings, nor ſeven-pence.

When there are ſeveral columns of one denomination they muſt be wrote by the directions in integers.

16.—Add 47*lb.* 10*oz.* 4*dr.* 2*sc.* 17*gr.*, 36*lb.* 7*oz.* 6*dr.* 1*sc.* 10*gr.*, 89*lb.* 4*oz.* 3*dr.* 2*sc.* 9*gr.*, 28*lb.* 11*oz.* 5*dr.* 0*sc.* 8*gr.*, 64*lb.* 8*oz.* 7*dr.* 2*sc.* 14*gr.*, 73*lb.* 6*oz.* 2*dr.* 1*sc.* 6*gr.*, 95*lb.* 9*oz.* 6*dr.* 2*sc.* 9*gr.*, and 46*lb.* 7*oz.* 4*dr.* 0*sc.* 17*gr.*, together.

17.—Add 73*A.* 2*R.* 24*P.*, 34*A.* 1*R.* 31*P.*, 46*A.* 2*R.* 29*P.*, 29*A.* 3*R.* 18*P.*, 18*A.* 0*R.* 32*P.*, 30*A.* 2*R.* 14*P.*, 6*A.* 1*R.* 27*P.*, and 9*A.* 3*R.* 36*P.*, together.

18.—Add 17*E.E.* 4*Q.* 3*N.*, 6*E.* 3*Q.* 1*N.*, 9*E.* 2*Q.* 2*N.*, 13*E.* 1*Q.* 3*N.*, 7*E.* 0*Q.* 0*N.*, 8*E.* 4*Q.* 2*N.*, 10*E.* 3*Q.* 3*N.*, and 11*E.* 2*Q.* 1*N.* together.

19.—Add 42*deg*, 17*Lea*, 2*mile*, 6*fur*, 27*P*, 2½*yd*, 2*ft*, 7*in*; 27*deg*, 9*lea*, 1*mile*, 7*fur*, 19*P*, 1*yd*, 0*ft*, 6*in*; 36*deg*, 12*lea*, 0*mile*, 3*fur*, 32*P*, 2½*yd*, 1*ft*, 10*in*; 84*deg*, 8*lea*, 2*mile*, 2*fur*, 28*P*, 3*yd*, 2*ft*, 8*in*; 17*deg*, 14*lea*, 1*mile*, 1*fur*, 19*P*, 4½*yd*, 0*ft*, 3*in*; 2*deg*, 17*lea*, 0*mile*, 5*fur*, 26*P*, 5*yd*, 1*ft*, 11*in*; 9*deg*, 9*lea*, 2*mile*, 4*fur*, 14*P*, 2*yd*, 2*ft*, 9*in*; and 6*deg*, 16*lea*, 1*mile*, 6*fur*, 37*P*, 4½*yd*, 0*ft*, 5*in*, together.

20.—Add 34*yds*, 3*qr*, 1*nail*; 27*yds*, 1*qr*, 2*n*; 83*yds*, 2*qr*, 3*n*; 59*yds*, 1*qr*, 3*n*; 46*yds*, 3*qr*, 2*n*; 5*yds*, 1*qr*, 1*n*; 38*yds*, 2*qr*, 2*n*; 62*yds*, 2*qr*, 2*n*; 25*yds*, 1*qr*, 3*n*; 17*yds*, 3*qr*, 1*n*; 54*yds*, 2*qr*, 3*n*; 36*yds*, 1*qr*, 2*n*; and 43*yds*, 3*qr*, 2*n*; together.

21.—Add 41*hhd*, 37*gal*, 2*qt*, 1*pint*; 29*hhd*, 28*gal*, 3*qt*, 1*pint*; 19*hhd*, 43*gal*, 1*qt*, 1*pint*; 31*hhd*, 29*gal*, 2*qt*, 1*pint*; 28*hhd*, 37*gal*, 3*qt*, 1*pint*; 17*hhd*, 28*gal*, 0*qt*, 1*pint*; 16*hhd*, 36*gal*, 2*qt*, 1*pint*; and 8*hhd*, 49*gal*, 1*qt*, 1*pint*; together.

22.—Add 27*bar*, 3*fir*, 6*gal*, 3*qt*; 36*bar*, 2*fir*, 3*gal*, 2*qt*; 28*bar*, 5*fir*, 4*gal*, 1*qt*; 14*bar*, 3*fir*, 2*gal*, 2*qt*; 9*bar*, 0*fir*, 5*gal*, 0*qt*; 6*bar*, 2*fir*, 7*gal*, 3*qt*; 7*bar*, 5*fir*, 3*gal*, 1*qt*; and 3*bar*, 4*fir*, 6*gal*, 2*qt*; of ale together.

23.—Add 273*chal*, 6*bu*, 2*pec*, 1*qt*; 84*chal*, 3*bu*, 1*pec*, 2*qt*; 47*chal*, 5*bu*, 3*pec*, 3*qt*; 128*chal*, 6*bu*, 0*pec*, 1*qt*, 36*chal*, 7*bu*, 2*pec*. 0*qt*; 95*chal*, 3*bu*, 1*pec*, 2*qt*; 74*chal*, 6*bu*, 3*pec*, 3*qt*; and 36*chal*, 5*bu*, 2*pec*, 0*qt*; of Corn.

24.—Add 17*T*, 12*cwt*, 2*qr*, 20*lb*; 24*T*, 19*cwt*, 1*qr*, 17*lb*; 36*T*, 6*cwt*, 3*qr*. 9*lb*; 18*T*, 8*cwt*, 2*qr*, 23*lb*; 29*T*, 14*cwt*, 1*qr*, 9*lb*; 26*T*, 6*cwt*, 3*qr*, 16*lb*; 9*T*, 7*cwt*, 1*qr*, 21*lb*; and 7*T*, 15*cwt*, 2*qr*, 14*lb*; together.

25.—Add 127*yr*, 7*mo*, 3*wk*, 6*day*, 17*hr*, 34*m*, 30*ſec*; 36*yr*, 8*mo*, 2*wk*, 5*day*, 21*hr*, 43*m*, 43*ſec*; 48*yr*, 9*mo*, 1*wk* 3*day*, 14*hr*, 28*m*, 28*ſec*; 96*yr*, 10*mo*, 2*wk*, 4*day*, 22*hr*, 52*m*, 36*ſec*; 27*yr*, 6*mo*, 3*wk*, 2*day*, 13*hr*, 28*m*, 42*ſec*; 8*yr*, 3*mo*, 1*wk*, 5*day*, 24*hr* 34*m*, 28*ſec*; and 6*yr*, 11*mo*, 2*wk*, 3*day*, 19*hr*, 26*m*, 17*ſec*; together.

COMPOUND SUBTRACTION.

TO ſubtract compound numbers, as money, weights, or meaſures.

RULE*.

Write the leſs quantity under the greater, ſo that each number thereof may ſtand under others only of the ſame name; then begin at the leaſt denomination, take each lower number from the higher, and where there is occaſion to borrow, borrow as many as are equal to one at the next place, that is, the place where you are to pay, or add one to the lower figure.

This rule is proved by adding the leſs number and difference together; the ſum will be the greater, if your work is true.

EXAMPLE.

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* EXAMPLE.—Subtract 16*l.* 14*s.* $9\frac{1}{2}$*d.* from 23*l.* 8*s.* $5\frac{1}{4}$*d.*

£.	*s.*	*d.*
23	8	$5\frac{1}{4}$
16	14	$9\frac{1}{2}$
6	13	$7\frac{3}{4}$

Write pounds under pounds, ſhillings, under ſhillings, &c. as in the example; then the only difference in ſubtracting betwixt theſe and whole numbers, is in borrowing—for inſtead of borrowing 10, you muſt here borrow as many as are equal to one where you pay it again; ſo that at farthings you borrow 4, at pence 12, and at ſhillings 20; pounds being the greateſt name are ſubtracted as whole numbers.

EXAMPLES.

		£.	s.	d.			£.	s.	d.
1.	From	273	13	4	2.	From	327	13	7
	Subtract	95	10	8		Take	197	18	10½

3—From 235l. 6s. 3½d. ſubtract 96l. 17s. 7¾d.
4—From 130l. 13s. 0d. ſubtract 26l. 14s. 11½d.
5—Subtract 13s. 7½d. from 3l. 7s.
6—Take ſeventeen ſhillings and 6 pence from three pounds.
7—From 47 guineas take 47 ſhillings.
8—Take 13 crowns from 4l. 2s. 6d.
9—Take 3 farthings from 3 pounds.
10—From 46l. 17s. 6d. ſubtract 34 guineas.
11—What is the difference betwixt 23l. 7s. 10½d. and 32l. 6s. 8d.
12—Borrowed 1340l. 16s. 8d, and paid again 568l. 0s. 10½. how much remains unpaid?
13—From 46cwt. 1qr. 7lb. take 29cwt. 3qr. 14lb.
14—Take 27yds. 2qr. 3n. from 42 yds. 1qr.
15—Take 120lb. 8dr. 3 oz. 2sc. 14gr. from 315lb. 4dr 3oz.
16—From 63lb. 5oz. 6dwt. ſubtract 36lb. 8oz. 12dwt. 14gr.
17—From 23 Acres, 3R. 17P. take 17 Acres, 3R. 29P.
18—From 1346 miles, 2 fur. 3 per. 4 yds. ſubtract 769 m. 6 fur. 14 per. 2 yds, 2 ft.
19—From 127 hhds, 34 gal. 2 quarts of wine, ſubtract 97hhds. 43 gal. 2 qts. and 1 pint.
20—From 33 hhds. 1 kilderkin of ale, ſubtract 17 hhds. 2 kilderkins, 1 firkin and 6 gallons.
21—From 36 quarters, 3 buſhels of corn, ſubtract 19 quarters, 6 buſhels, and 3 pecks.
22—Subtract 7 months, 2 weeks, 4 days, 6 hours, and 23 minutes from one year.

COMPOUND MULTIPLICATION.

TO multiply compound quantities, as pounds, ſhillings and pence, &c.

RULE*.

Firſt multiply the leaſt denomination, reduce the product to the next greater, and write down the remainder; then multiply the next denomination, to the product add the number obatined by reduction, then reduce the ſum to the next greater denomination, write down the remainder as before; thus do with every denomination; and write down the whole at the laſt place.

EXAMPLES.

		£.	s.	d.		£.	s.	d.
1.	Multiply	27	13	4	Multiply	6	18	9¾
	By -			4	By			6

2—Multiply

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* EXAMPLE.—Multiply 16*l.* 17*s.* 9¾*d.* by 9.

£.	s.	d.
16	17	9¾
		9
£.152	00	3¾

Firſt multiply the farthings and reduce the product to pence, make 4 pence and 3 farthings, write down the 3 farthings; then multiply the pence, add the 4 pence obtained by reduction to the product, reduce the ſum to ſhillings, make 7*s.* 3*d.*; then multiply the ſhillings, add 7 to the product, and reduce the ſum to pounds, make 8*l.* 00*s.*, write 0 in the ſhillings place, then multiply the pounds as whole numbers, add the 7*l.*, make 152*l.*; ſo the product is 152*l.* 0*s.* 3¾*d.*

Thus

2—Multiply 4l. 17s. 9½d. by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.
3—Multiply 24l. 3s. 10¼d. by 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.
4—Multiply 16s. 8¾d. by 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.

If you can find two or more ſuch numbers, that their product will be the multiplier, you may firſt multiply by one of them and that product by another, and ſo on; the laſt product will be the ſame as if you had multiplied by the product of all thoſe multipliers at once.

5—Multiply 17l. 13s. 8d. by 16, 20, 24, 28, 32, and by 36.
6—Multiply 7s. 9½d. by 25, 30, 35, 40, 45, and by 50.
7—Multiply 3l. 12s. 8¾d. by 36, 42, 48, 54, 60, and by 66.
8—Multiply 7l. 17s. 8¼d. by 49, 56, 63, 70, 77, and 84.

9—Multiply

Thus proceed with any ſingle figure, taking care to reduce each product to the ſame denomination with the next product to which the number ſo obtained is to be added.

EXAMPLE.—Multiply 2*l.* 14*s.* 7¼*d.* by 56.

£.2	14	7¼
		8
21	16	10
		7
152	17	10

To multiply by 8 and that product by 7 is the ſame as to multiply by 56, becauſe 7 times 8 is 56.

£.	*s.*	*d.*
2	14	7¼
		8
21	16	10
		7
152	17	10
5	9	2½
£.158	7	0½

Multiply 2*l.* 14*s.* 7¼ by 58.

Multiply by 8 and that product by 7, makes 56 times, to which add the given multiplicand multiplied by 2, the ſum is 58 times; thus when you cannot make the multiplier exact, you may make it as near as you can and add or ſubtract ſo many times the given multiplicand as it is ſhort of or exceeds the ſaid multiplier.

EXAMPLE.

Or you may multiply by the compound quantity, firſt multiplying by the leaſt denomination, and reduce the product to the next greater; then write the next product directly under the number obtained by reduction to be added thereto, and ſo on.

9—Multiply 20l. 0s. 11¾d. by 64, 72, 80, 88, and 96.
10—Multiply 1l. 14s. 11½d. by 126, 252, 336, 567, and by 1000.

If you cannot find numbers to produce the multiplier, take ſuch as will be as near as you can, and add or ſubtract as many times the original multiplicand as the product of your multiplier is ſhort of, or exceeds the real multiplier.

11—Multiply 7l. 11s. 10d. by 37, 50, 128, 364, 287, and by 749.
12—Multiply 14l. 7s. 10½d. by 327, 106, 3009, 7048, and 10073.
13—Multiply 7 cwt. 3 qr. 12lb. by 23, 37, 148, and by 369.

14—Multiply

Example.—Multiply 2*l.* 14*s.* 3¾*d.* by 174.

```
     £.   s.   d.
               174
      2   14    3¾
     ___________
          4)522
          _____
           130½
            522
          _____
         12)652
    S.       54 4d.
            696
            174
         ______
       20)249 0s.
          124 10
          348
       __________
Product. £.472 10 4½
       __________
```

Multiply 174 by 3 farthings, the product is farthings, which reduce to pence, make 130 pence; then multiply by 3 pence, write the product directly under 130*d.* then add and reduce the ſum to ſhillings, make 54 ſhillings; then multiply by 14*s.* write the product under 54*s.* the ſum when added is 2490*s.* reduced to pounds make 124*l.* 10*s.* then multiply by 2, write the product under 124*l.* and add it thereto, and the product is 472*l.* 10*s.* 4½*d.*

This

14—Multiply 2l. 14s. $7\frac{1}{2}$d. by 1296.
15—Multiply 2l. 16s. $9\frac{1}{2}$d. by 84, 79, 256, and by 379.
16—What will 4968 yards come to at 13s. $4\frac{1}{2}$d. per yard?
17—What will 735 hundred weight come to at 1l. 17s. $11\frac{3}{4}$d. per hundred weight?

Work the following examples by any the moſt convenient of the foregoing methods.

18—What will 24 yards of cloth come to at 7s. 4d. per yd?
19—What will 48 yards come to at 13s. $10\frac{1}{4}$d. per yd.
20—What will 96 yds. come to at 1l. 17s. $11\frac{1}{4}$.d and 128 at 3l. 14s. $8\frac{3}{4}$d?
21—If 1 cwt. coſt 1l. 17s. $6\frac{3}{4}$d. what will 74, 128, 397, and 468 cwt. coſt?
22—How many yards of cloth are in 54 pieces, each piece containing 27 yards 2 qrs. 3 nails?
23—What is the weight of 19 hogſheads of ſugar, when each weighs 17 cwt. 2 qrs. 17 lb.
24—If 1lb. of tea coſt 5s. 9d. what will one hundred weight come to at that rate?

COMPOUND DIVISION.

TO divide compound quantities, as of money, weights, meaſures, &c.

RULE.

Divide the greateſt denomination as in whole numbers, reduce the remainder to the next leſs, add the given parts of the ſame name to the product; divide the ſum by the ſame diviſor, reduce the remainder as before; thus proceed till you have brought it to its loweſt terms, or till nothing remain,

Each

This method not only ſaves the trouble of finding new multipliers, but will anſwer for all numbers and denominations whatever.

It is evident that any number of yards, hundred weights, pounds, &c. will coſt as many times the price of one, wherefore the price multiplied by the quantity will give the whole price or value.

Each quotient is of the ſame denomination with the dividend from which it is obtained, and ſo is each remainder*.

EXAMPLES.

1—Divide 347l. 16s. 8d. by 16, 24, 96, and by 87.
2—Divide 147l. 18s. 11½d. by 38, 49, 128, and by 236.
3—Divide 247 cwt. 3 qr. 21 lb. by 7, 9, 33, and by 148.

When the diviſor does not exceed the number 12, you may work by ſhort diviſion, keeping the operation in memory, and only write down the quotient figures.

```
4        6)39  14  9          9)27  18  4½.
          ___________           ___________

          ___________           ___________
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5—Divide 127l. 15s. 8d. by 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and by 12.

6—Divide

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* EXAMPLE.—Divide 274*l.* 13*s.* 9*d.* by 34.

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    £.    s.  d.  £.   s.  d.
34)274   13   9 (8    1   6¾
   272
   ———
     2
    20   s.
   ————
34) 53(1s.
    34
   ———
    19
    12
34)237(6d.
   204
   ———
    33
     4
   ————
34)132(3f.
   102
   ———
    30
```

Divide the pounds as in whole numbers, the quotient is 8*l.* reduce the remainder to ſhillings, taking the 13*s.* in to the product, divide thoſe ſhillings by the ſame diviſor, the quotient is 1 ſhilling, reduce the remainder to pence, taking the 9*d.* to the product, and divide thoſe pence by the ſame diviſor, the quotient is 6 pence; reduce the remainder to farthings, and divide thoſe farthings, the quotient is 3 farthings—ſo the whole quotient is 8*l.* 1*s.* 6¾*d.* and the remainder is 30 farthings.

EXAMPLE.

6—Divide 146l. 19s. by 2, 7, 5, 9, 2, 11, 6, 12, 4 and 8.
7—Divide 387l. by 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.

If there be ciphers on the right hand of your diviſor, you may cut them off, and as many figures from the right hand of each dividend; but the figures cut from the dividend muſt be again annexed to the remainder to make the remainder complete.

8—Divide 2768l. 13s. 10d. by 10, 30, 20, 70, 90, 110, and 120.
9—Divide 1476l. 17s. 8d. by 200, 40, 800, 5000, 1100, and 1200.

If you can take two or more ſuch numbers that their product will be the diviſor, you may divide by one of them and that quotient by another, and ſo on; the laſt quotient will be that required.

E 10—Divide

Example.—Divide 27*l.* 13*s.* 4*d.* by 6.

	£.	s.	d.
6)	27	13	4
	4	12	$2\frac{2}{3}$

This may be done by ſhort diviſion, keeping the work in memory, and only write down the quotient figures, as in the example.

Example.—Divide 37*l.* 14*s.* 6*d.* by 42.

	£.	s.	d.
6)	37	14	6
7)	6	5	9
	0	17	$11\frac{1}{2}$

Becauſe 7 times 6 is 42, to divide by 6 and that quotient by 7, is the ſame as to divide by 42 at once.

Example.—Multiply 7*l.* 6*s.* 8*d.* by $\frac{7}{8}$.

	£.	s.	d.
	7	6	8
			7
8)	51	6	8
	6	8	4

To multiply by $\frac{7}{8}$, multiply by 7 and divide by 8, the quotient is the product required.

Example.

10—Divide 746l. 8s. 11d. by 24, 42, 63, 80, and by 108.
11—Divide 371l. 19s. by 28, 48, 70, 88, and by 120.
12—Divide 84l. 19s. by 36, 56, 72, 90, and by 132.

To multiply by a Fraction—Multiply by the numerator, and divide the product by the denominator.

13—Multiply

Example.—Divide 7*l.* 6*s* 8*d.* by $\frac{7}{8}$.

	l.	s.	d.
	7	6	8
			8
7)	58	13	4
	8	7	$7\frac{3}{7}$

But to divide by $\frac{7}{8}$, multiply by 8 and divide the product by 7 as in the example.

Example.—Multiply 2*l.* 3*s.* 4*d.* by $6\frac{3}{4}$.

	£.	s.	d.
	2	3	4
			3
4)	6	10	0
	1	12	6
	13	0	0
	14	12	6

Multiply by $\frac{3}{4}$ as in the laſt example, then multiply by 6, theſe two products added together is the product required.

Example.—Divide 14*l.* 12*s.* 6*d.* by $6\frac{3}{4}$.

$6\frac{3}{4}$)	14	12	6(
4			4
27)	58	10	0(2*l.* 3*s.* 4*d.*
	54		
	4		
	20		
27)	90 (3*s.*		
	81		
	9		
	12		
27)	108 (4*d.*		
	108		

Multiply 6 by 4 and add 3 to the product for a diviſor; multiply alſo the dividend 14*l.* 12*s.* 6*d.* by 4 for a new dividend; divide as in the firſt example, and the quotient is 2*l.* 3*s.* 4*d.*

The

13—Multiply 3l. 16s. 7d. by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{8}$, $\frac{9}{16}$, and $\frac{10}{24}$.

To multiply by a Fraction and a Whole Number—Multiply by each, and add their products together.

14—Multiply 3l. 14s. $5\frac{1}{2}$d. by $2\frac{1}{2}$, $7\frac{3}{4}$, $6\frac{5}{8}$, $17\frac{4}{9}$, and $24\frac{13}{16}$.

To divide by a Fraction—Multiply by the denominator, and divide the product by the numerator.

15—Divide 4l. 13s. 7d. by $\frac{2}{3}$, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{7}{8}$, $\frac{5}{6}$, $\frac{9}{12}$, $\frac{17}{24}$, and $\frac{5}{16}$.

To divide by a Whole Number and a Fraction—Multiply the whole number by the denominator of the fraction, to the product add the numerator for a new diviſor, then multiply the dividend by the ſame denominator for a new dividend, divide and the quotient will be that required.

16—Divide 48l. 7s. 9d. by $3\frac{1}{2}$, $7\frac{3}{4}$, $6\frac{5}{6}$, $4\frac{2}{3}$, $17\frac{3}{8}$, and $24\frac{9}{16}$.

PROMISCUOUS QUESTIONS.

1—Divide 174l. 13s. 9d. by 32, 45, 60, 77, 96, and $37\frac{1}{2}$.
2—Divide 7948l. 17s. 4d. by 192, 252, 441, and $176\frac{5}{8}$.
3—Divide 184l. 10s. by 196, 384, 616, 540, and $246\frac{3}{4}$.
4—Divide 3647l. 14s. 8d. by 216, 432, 756, and $236\frac{2}{3}$.
5—Divide 274cwt. 3qr. 17lb. by 7, 29, 36, $47\frac{1}{4}$, and $38\frac{3}{4}$.

The value divided by the quantity gives the price.

Example.—Divide 7*l.* 4*s.* 6*d.* among three men, A, B, and C, and give B twice as much as A, and C as much as both A and B.

```
6)7  4  6
  --------
  1  4  1  A's ſhare.
  2  8  2  B's.
  3 12  3  C's.
  --------
  7  4  6  Proof.
  --------
```

Becauſe B has 2 times A's ſhare, and C 3 times A's ſhare, the whole is 6 times A's ſhare, and A's ſhare is a 6th of the whole, therefore divide by 6 and the quotient is A's ſhare, multiply A's ſhare by 2 for B's, add A's and B's together for C's, add A's, B's, and C's together for the proof.

6—What is the price of one yard of cloth when 36 yards coſt 13l. 19s. 9d.?
7—What is the ſeventh part of 158l. 5s. 9d.?
8—What is the ninety-ſixth part of 318cwt.
9—What is the difference between 1463 and 1967?
10—What is the ſum of 4160, 45723, and 6785434?
11—What is the product of 146 and 27?
12—What is the ſeventh part of 427?
13—Divide 63744 into twelve equal parts.
14—Subtract 8¾ pence from 5l. 7s. 6¼d.
15—Gave 22s. 4¾d. for 18½lbs. of ſugar, what is it per lb?
16—What will a piece of Iriſh linen come to 26½ yards long at 22½d. per yard?
17—What is the Sum and difference of 56l. 5s. 4½d. and 3l. 15s. 0¼d?
18—What will 40000 bricks come to at 16s. 6d. per thouſand?
19—What will 105 feet of timber come to at 18½d. per foot?
20—What will a bag of cotton, weighing 3cwt. 2qr. come to at 15½d. per lb.?
21—159l. 19s. 10d. is to be equally divided among eight men, what is each man's ſhare?
22—What does 10 yards of broad cloth come to at 18s. 6d. per yard?
23—If 10 dozen of hats coſt 5l. 15s. what do they coſt per dozen, and what is the price of each hat?
24—Gave 7s. 9d. per pair for 6 pair of ſhoes, and 6s. 5d. per pair for 7 pair, whether parcel coſt more, and how much?
25—What will 3 dozen pairs of gloves come to at 22½d. per pair?
26—If 45 yards of flannel coſt 2l. 5s. 6d. what is it per yard?
27—How much will 59 gallons of rum come to at 8s. 6d. per gallon?
28—Add 300l. 14s. 6d. to the 95th part of 1000l. 2s. 1d.
29—What ſum will pay 43 workmen a week's wages at 2s. 4d. per day each?
30—An equal number of men, women and boys worked together the ſame time till they had earned 4l. 5s. the

the men were allowed 16d. per day, the women 10d. and the boys 4d. per day each; how many days did each work?

31—The ſum of 36l. is to be divided among an equal number of men, women and children, each man is to have 2s. 8d. each woman 1s. 8d. and each child 8d.—How many of each will receive it?

32—The ſum of 3l. 13s. 6d. is to be divided among 21 men, 21 women, and 21 children, ſo that each woman is to have as much as two children, and each man as much as a woman and a child—How much muſt each have?

33—246 ounces of ſilver is to be made into an equal number of ſpoons, ſalts and cups, each ſpoon to weigh 2 oz. each ſalt $4\frac{1}{2}$ ounces, and each cup 14 ounces—How many of each will it make?

THE SINGLE RULE OF THREE.

THIS is called the Rule of Three, becauſe there are three numbers given—It is alſo called the Rule of Proportion, becauſe we are required to find a fourth number in the ſame proportion to the third which the ſecond bears to the firſt.—It is ſometimes called the Golden Rule becauſe of its excellence and uſefulneſs; for the greateſt part of the mathematics depends on the doctrine of proportion: wherefore this rule ought to be carefully attended to, and well underſtood by every perſon who wiſhes to obtain a competent knowledge of Arithmetic.

RULE.

Write the three given numbers in a line thus 1 : 2 : : 3 : with two points between the firſt and ſecond, and four points between the ſecond and third—this is called ſtating the queſtion; in doing which take care that the third number be that which requires the anſwer, that the firſt and third be both of one kind, and that the middle term be of the ſame kind which the anſwer muſt be of.

Then you may obſerve, that the firſt term has the ſame relation to the ſecond that the third has to the number ſought.

Multiply the ſecond and third numbers one by the other, and divide the product by the firſt, the quotient will be the anſwer, if the queſtion is in direct proportion *.

EXAMPLES.

1—If 7 yards of cloth coſt 35 ſhillings, what will 46 yards of the ſame coſt?

2—If

---

* EXAMPLE.—What will 24 yards of cloth come to when I may have 7 yards for 28 ſhillings?

```
y.   s.    y.
7 : 28 : : 24
    24
   ———
   112
   56
   ——————  s.
7)672 ( 96—4l. 16s.
```

Becauſe the price of 24 yards is required, put 24 for the third term, and becauſe the price of 7 yards is given, put 7 for the firſt term; then the firſt and third terms being both yards, or meaſure, are both of one kind. The price being required, put 28s. the given price in the middle; then it is evident that the ſecond term has the ſame relation to the firſt that the anſwer is required to have to the third, viz. the middle term is the price of the firſt, and the anſwer muſt be the price of the third; wherefore the queſtion is properly ſtated, two points being put between the firſt and ſecond term, and four between the ſecond and third, ſignify proportionality, and are read thus, as 7 is to 28 ſo is 24. Multiply the ſecond and third terms together and divide the product by the firſt, the quotient is 96 ſhillings, reduced to pounds make 4l. 16s. for the anſwer, which put for the fourth term in the ſtating thus, as 7 : 28 :: 24 : 4l. 16s. will be read, as 7 yards is to 28s. ſo is 24 yards to 4l. 16s.

That this method of operation is true, let the ſecond term be divided by the firſt, and the quotient multiplied by the third; for it is evident that the price of one yard is the ſeventh part of the price of ſeven yards, and that 24 yards will coſt 24 times as much as one yard; or which is the ſame thing, if the price of 7 yards be multiplied by 24, the product will be the price of 24 times 7 yards, or 7 times 24 yards, one ſeventh of which is the price of 24 yards.

EXAMPLE.

2—If 7 yards of cloth coſt 35 ſhillings, how many yards of the ſame may I have for 120 ſhillings?

3—What will 43 yards of cloth coſt, when I may have 7 yards of the ſame for 21 ſhillings?

If any of the terms be compound, it muſt be reduced to a ſimple quantity, that is, to the loweſt name mentioned;—the firſt and third muſt both be reduced to the ſame name.—The quotient will be of the ſame denomination which the middle term was left in, ſo will the remainder, which muſt be reduced as in compound diviſion.

4—If 17 yards of cloth coſt 5l. 19s. what will 173 yards coſt at the ſame rate?

5—What muſt I give for 147¾ yards of cloth, when 13 yards of the ſame coſt 3l. 5s.?

6—If 14 yards of cloth coſt 7l. 7s. what will 47¾ yards of that cloth come to?

7—What will 147 yards of cloth come to at the rate of 26 yards for 9l. 14s. 6d.?

8—What muſt I give for 14 cwt. 3 qr. 14lb of tobacco, when I may have 6 cwt. for 33l.?

9—If I buy 27 cwt. 3 qr. of ſugar for 77l. what is it per cwt.?

10—If

Example.—If 7 yards coſt 1*l.* 8*s.* what will 46¾ yards coſt?

```
      y.   l.  s.     y.   l.  s.
as    7 :  1   8 :: 46¾ :  9   7
      4   20         4
      —    —       ————
     28   28       187
                    28
                  —————
                  1496
                  374
                  ————— s.    l.  s.
               28)5236(187—9   7
```

State the queſtion as before, and becauſe the middle term is pounds and ſhillings reduce it to ſhillings, and becauſe the third is yards and quarters reduce it to quarters, the firſt muſt be reduced to quarters alſo, becauſe the firſt and third muſt be both in one name; then multiply and divide as before, the quotient is ſhillings, becauſe the middle term was reduced to ſhillings. If there ſhould be a remainder, it may be reduced to the next lower name as in compound diviſion.

In

10—If 17 cwt. of tobacco coſt 95l. 4s. what is it per cwt. and what per lb.?

11—If 100l. gain 4l. 10s. intereſt in 12 months, what will 746l. 15s. gain in the ſame time?

12—How far will a man travel in 56 days, who travels 240 miles every 8 days?

13—If a man buy 368 yards of cloth for 161l. what muſt he ſell 17 yards of the ſame for to gain 18l. 8s. by the whole?

14—If a pack weight be carried 48 miles for 17s. 6d. how far may it be carried for 6l. 11s. 3d.?

When more requires more, and leſs requires leſs, the queſtion is in direct proportion, and you muſt multiply the ſecond and third numbers together, and divide by the firſt, as in the foregoing examples.

But if more requires leſs, and leſs requires more, the queſtion is in inverſe proportion, and you muſt multiply the firſt and ſecond numbers one by the other, and divide the product by the third, the quotient will be the anſwer.

EXAMPLES.

15—How many men will be able to do as much work in 17 days as 7 men can do in 119 days?

16—If

In the foregoing queſtion it is evident that greater the quantity and greater the price muſt be; more requires more, that is, more yards will coſt more money, wherefore the proportion is direct; but but in the following queſtion, viz.

EXAMPLE.—In how many days will 8 men do as much work as 6 men will perform in 12 days?

M. *D.* *M.* *D.*
as 6 : 12 :: 8 : 9
6
——— *D.*
8)72(9 Anſwer.

Here more requires leſs and leſs requires more; for it is evident that a greater number of men will perform the ſame work in a proportionably leſs number of days, and that a leſs number of men would require a greater number of days, ſo that as the third term increaſes the anſwer muſt diminiſh, and as the third term leſſens the anſwer increaſes; wherefore the queſtion is in inverſe proportion, and the

firſt

16—If a man perform a journey in 8 days, when the days are 12 hours long, in how many days will he perform the ſame journey when the days are 16 hours long, if he walk at the ſame rate?

17—If an acre of land be 32 poles long, it muſt be 5 poles broad; but if the length be 20 poles, what muſt the breadth be to make an acre?

18—What length of 3 quarters wide ſtuff will line 14 yards of cloth which is $1\frac{3}{4}$ yards wide?

Direct and Inverſe Proportion promiſcuouſly.

19—If 24 cwt. be carried 36 miles for 3l. 4s. what muſt be given for the carriage of 32 cwt. the ſame journey?

20—If 24 cwt. be carried 36 miles for 3l. 4s. how far may 32 cwt. be carried for the ſame money?

21—If

---

firſt and ſecond terms muſt be multiplied together, and the product divided by the firſt as in the example.

Any queſtion in the Rule of Three may be contracted, if you can divide both firſt and ſecond, or firſt and third terms both by the ſame number, as in the following example.

If 6 yards coſt 9*s.* what will 17 yards coſt?

```
   y.  s.     y.    s.  d.
   6 : 9  ::  17 :  25  6
or 2 : 3  ::  17 :  25  6
               3
             ----
            2)51
             ----
             25-6
```

Divide the two firſt terms by 3, the quotients 2 and 3 put for thoſe numbers reſpectively will give the ſame anſwer as appears by the work. But if the queſtion is in inverſe proportion, you may divide the third and one of the other by one and the ſame number when it can conveniently be done.

When there are more numbers than are neceſſary recited in the queſtion, you muſt diſtinguiſh by which the anſwer is limited; as

EXAMPLE.—If 100*l.* gain 5*l.* intereſt in 12 months, what will 217*l.* gain in the ſame time?

```
   l.    l.     l.     s.   s.
as 100 : 5  ::  217 :  10   17
```

The time being the ſame to both ſums, the intereſt is only limited by the principal.

Sometimes the terms want ſome preparation before the general operation, as when the coſt, charges, and gain are to be added together for the price to be ſold for, &c.

21—If 24 cwt. be carried 36 miles for 3l. 4s. how far may the ſame weight be carried for 11l. 4s.?

22—If 7 cwt. of tobacco coſt 19l. 2s. 8d. what muſt be given for 46 cwt. 14lb. at the ſame rate?

23—If the ſix-penny white loaf weigh 4 lb. 5 oz. when wheat is at 12s. the buſhel, what ſhould the ſix-penny white loaf weigh when wheat is at 16s. the buſhel?

24—If 7 yards of cloth which is 2 yards wide will make a cloak, how much 3 quarters wide ſtuff will line it?

25—A draper bought 247 yards of cloth for 185l. 5s. and would gain 12l. 7s. by the whole, he deſires to know what he muſt ſell 19$\frac{3}{4}$ yards of that cloth for?

26—A merchant bought 480 cwt. 3 qr. of ſugar for 1312l. 6s. and deſires to know how he muſt ſell it per cwt. to gain 140l. by the whole?

27—A merchant ſold ſugar for 3l. 2s. per cwt. and found he had gained 140l. 12s. 6d. by ſelling 468 cwt. 3qr. what did the ſaid 468 cwt. 3 qr. coſt him?

28—If 100l. gain 5l. intereſt in 12 months, what will 784l. 10s. gain in the ſame time?

29—If 100l gain 5l. intereſt in 12 months, what ſum will gain 39l. 4s. 6d. in the ſame time?

30—If 100l. gain 5l. intereſt in 12 months, what will it gain in 33 months?

31—If 100l. gain 5l. intereſt in 12 months, what ſum will gain the ſame intereſt in 9 months?

32—If 100l. gain 5l. intereſt in 12 months, in what time will 375l. gain the ſame intereſt?

33—If 27 cwt. be carried 36 miles for 8l. 16s. how far may 19 cwt. be carried for the ſame money?

34—If 14 cwt. be carried 28 miles for 2l. 16s. how far may 45$\frac{1}{2}$ cwt. be carried for the ſame money?

35—If 14 cwt. be carried 28 miles for 2l. 16s. how much weight may be carried 8 miles and 5 furlongs for the ſame money?

36—Bought at Jamaica 960 gallons of rum for 108l, freight and other expences came to 12l. duty 240l. Charge of the cellar and porterage came to 8l. now I deſire to know what 36 gallons of that rum muſt be ſold for to gain 36l. by the whole?

37—What is the value of 40 dozen lbs. of candles when 6 dozen coſt 1l. 11s. 6d. and what are they per lb.?

38—How many men will do as much work in 14 days as 12 men can perform in 49 days?

39—If a firkin of butter which weighs 56 lb. coſt 1l. 2s. 2d. what is it per pound?

40—What is the yearly rent of 247½ acres of land at 19s. 4½d. per acre?

41—What is the height of a tower which gives a ſhadow 68 yards long, when a ſtaff 3 feet long gives 4 feet 7 inches of ſhade?

42—A bankrupt makes a dividend of 7s. 9d. per l. what will be received for a debt of 740l. 10s.?

43—A gentleman ſpends 19s. 4d. per day, whoſe income is 460l. per year, what does he lay by at the year's end?

44—What is the value of 12 pieces of fuſtian each piece containing 28½ yards at 2s. 3½d. per yard?

45—In what time will 327l. gain as much intereſt as 1280l. will gain in 7½ months?

46—A beſieged garriſon of 840 men have 14 weeks proviſions, which are required to laſt them 21 weeks, how many men muſt be turned out, and how many muſt remain?

47—What will 346l. 15s. gain at 5 per cent. that is at 5l. per 100l.?

48—How much tobacco at 17½ per lb. will purchaſe 112 lb. of ſugar at 6½d. per lb.?

49—What will 460 tons of lead come to at 18l. 7s. 6d. per fother of 19½ cwt.?

50—How many yards of kerſey at 3s. 4d. per yard muſt be given for 48 yards of broad cloth at 16s. 10d. per yard?

51—What ſum will pay the land tax for an eſtate of 240l. 16s. yearly rent at 4s. per pound?

52—If 14 yards of cloth coſt 5l. 5s. what will 376¾ yds. coſt at that rate?

53—How many yards of cloth may I have for 141l. 5s. 7½d. when 14 yards of the ſame is worth 5l. 5s.?

54—What do 14 yards of cloth coſt that perſon who paid 141l. 5s. 7½d. for 576¾ yards of the ſame ſtuff?

55—If 7 yards of ſtuff will line $4\frac{1}{2}$ yards of cloth of another breadth, how much of the ſame ſtuff will line 36 yards of that cloth?

56—If I buy 360 yards of cloth for 90l. what muſt I ſell 7 yards of that cloth for to gain 15l. by the whole?

57—What will 7 bags of cotton, weighing 32 cwt. 3 qr. 7 lb. come to at 6l. 14s. per cwt.

58—What will 32 cwt. 3 qr. 7 lb. of cotton come to at $15\frac{1}{2}$d. per pound?

59—A grocer bought 46 cwt. 3 qr. 14 lb. of ſugar for 257l. 16s. 3d. what muſt he ſell it for per cwt. to gain 32l. 4s. 7d. by the whole?

60—A grocer ſold 46 cwt. 3 qr. 14 lb. of ſugar at 6l. 3s. 9d. per cwt. and gained 32l. 4s. 7d. by the whole, what did it coſt him?

61—A merchant bought at Jaimaica 14 puncheons of rum containing 1176 gallons, for 137l. 4s. freight coſt him 8l. 8s. loading and unloading 2l. 2s. inſurance 1l. 8s. cuſtom 294l. and he would gain 58l. 16s.; what muſt he ſell it for per gallon, and what per puncheon of 82 gallons?

62—How much in length that is 8 inches broad will make a ſquare foot?

63—If 4 men earn 3l. 15s. in 6 days, how much will 21 men earn in the ſame time?

64—A perſon bought 32 pieces of cotton for 73l. 13s. 4d. at 20d. per yard, how many yards were there in each, and how many in the whole?

65—A lever is 42 inches long on one ſide the fulcrum, and 14 inches on the other, how much weight at the ſhorter end will balance 56 lb. on the longer?

66—If 6 men do a piece of work in 96 days, how many men would do the ſame in 12 days?

67—A merchant bought 3600 lbs. of cotton wool which he ſold at 22d. per lb. and gained 15l. what did the whole coſt him?

68—What muſt I give for 49 cwt. 3 qr. 7 lb of tobacco when 7 cwt. coſt 49l.?

69—If 50l. gain 2l. 10s. intereſt in 12 months, what will 375l. 10s. gain in the ſame time?

70—How much principal will gain 18l. 15s. 6d. intereſt in 12 months, when 50l. gains 2l. 5s. in one year?

71—How much paper 21 inches broad will paper the walls of a room which meaſures 26 yards about and 7 feet in height?

72—If 365l. 10s. gain 18l. 5s. 6d. intereſt in 12 months, in what time will 121l. 16s. 8d. gain the ſame?

73—If 3l. 15s. maintain a family of 8 perſons 4 weeks, how much will maintain the ſame family the whole year?

74—How much inkle at 3 yards a penny will purchaſe a horſe of 10l. value?

75—What is the value of 23 packs of wool, each weighing 16 ſtone, at 9s. 4d. per ſtone?

76—A perſon travelling conſtantly at the rate of 2¾ miles an hour, another ſets out from the ſame place 5 hours after him and travels the ſame road at the rate of 4 miles an hour, in what time will he overtake the former?

77—A draper buys 246 yards of cloth at 4s. 6d per yd. which he ſells again at 5s. 4d. per yard, how much does he gain by the whole?

78—If I buy ſugar at 2l. 16s. 8d. per cwt. and ſell it again at 3l. 2s. 4d. per cwt. what do I gain per cent. that is, at laying out 100l.?

79—A tradeſman breaking compounds with his creditors for 13s. 4d. per pound, what muſt that creditor receive to whom he owes 1256l. 10s.?

80—A bankrupt owes 1256l. 10s. and his effects are found to be worth no more than 784l. 10s. what does he pay in the pound, and what per cent.?

THE DOUBLE RULE OF THREE.

IN the Double Rule of Three there are five numbers given to find a ſixth, which muſt bear the ſame proportion to the fourth and fifth which the third bears to the firſt and ſecond.

RULE*.

To work by two ſtatings,

Put that number for the middle term which is of the ſame kind with the anſwer, the third muſt be one of thoſe which requires the anſwer, the firſt muſt be of the ſame kind with the third; work this as a ſingle rule queſtion, and write the anſwer for the middle term in the ſecond ſtating, write the other term which requires the anſwer for the third, and that which is of the ſame kind therewith for the firſt; work this alſo as a ſingle rule queſtion, and if the queſtion requires more ſtatings than two, proceed in the ſame manner with every one till all the terms moving the queſtion be done, the anſwer to the laſt ſtating will be the anſwer to the queſtion.

To work by one ſtating.

Write that number for the middle term which is of the ſame kind with the anſwer, write thoſe after the middle which require the anſwer, and thoſe before it which give the middle for an anſwer; and obſerve that the firſt, and firſt after the middle be both of one kind; the ſecond, and ſecond after the middle both of one kind, &c.

If

---

* Example.—If 4 men work 16 rods of ditching in 3 days, how many rods will 12 men work in 6 days at the ſame rate?

To work this by two ſtatings, write that in the middle which is of the ſame kind with the required anſwer, that is rods, then write one of thoſe which require the anſwer for the third, that is, either 12 men or 6 days make the firſt that which is of the ſame kind with the third; work this as a ſingle rule queſtion, write the anſwer for the middle term in the ſecond ſtating, and the other number requiring the anſwer for the third; here becauſe men were

```
       M.   R.     M.   R.
  as   4 : 16 :: 12 : 48
       D.   R.     D.   R.
       3 : 48 ::  6 : 96
            Or,
   M.  D.   R.     M.   D.
   4 : 3 : 16 :: 12 : 6
   3       12
   —       ———
   12      192
             6 R.
         ————
     12)1152(96
```

If any two terms make an inverſe proportion, change their places, the one for the other, thus do with every inverſe part; then multiply the middle term and thoſe that follow it one into another for a dividend; multiply all the terms before the middle one into another for a diviſor—divide, and the quotient will be the anſwer.

EXAMPLES.

1—If a man travel 240 miles in 8 days when the days are 12 hours long, how many miles will he travel in 24 days when the days are 16 hours long.

2—If 46 cwt. be carrried 28 miles for 2l. 7s. what muſt be paid for the carriage of 184 cwt. 84 miles?

3—How far may 273 cwt. be carried for 17l. 16s. when 23 cwt. is carried 96 miles for 6l. 14s.?

4—If 24 ſheep be at graſs 8 weeks for 3l. 4s. how many ſheep may go in the ſame paſture 13 weeks for 9l. 16s.?

5—When the days are 16 hours long, how many men will do as much work in 24 days as 18 men will perform in 36 days when the days are but 12 hours long?

6—If 7l. 16s. be ſufficient to maintain a family of 8 perſons 7 weeks, how much will maintain a family of 12 perſons the whole year?

---

were taken in the firſt ſtating, days are left for the ſecond; make alſo the firſt and third both of one kind: work this as a ſingle rule queſtion, the anſwer is that required.

Or, if you work by one ſtating of five numbers, write that for the middle term which is of the ſame kind with the anſwer, that is 16 rods; the two terms which require the anſwer muſt be the fourth and fifth, viz. 12 men and 6 days; the firſt and firſt after the middle muſt be both of one kind (here they are both men;) the ſecond, and ſecond after the middle muſt be both of one kind (here they are both days;) then multiply the firſt and ſecond terms together for a diviſor, and the third fourth, and fifth for a dividend, which divide, and the quotient 96 rods is the anſwer.

If any of the terms make an inverſe proportion, they muſt be inverted by changing their places, as in the following

EXAMPLE.

7—If 100l. gain 5l. intereſt in 12 months, what will 347l. 15s. gain in 21 months?

8—How far may 126 cwt. 3 qr. 14 lb. be carried for 27l. 14s. 6d. when the carriage of $7\frac{1}{2}$ cwt. 30 miles coſt 2l. 2s. 6d.?

9—How many perſons will 86l. 18s. $3\frac{1}{2}$d. maintain one year when 7l. 16s. maintains 8 perſons 7 weeks?

10—How long will 86l. 18s. $3\frac{1}{2}$d. maintain a family of 12 perſons, when 7l. 16s. will maintain 8 perſons 7 weeks?

11—If 100l. gain 4l. 10s. intereſt in 12 months, how much money will gain 17l. 4s. $5\frac{1}{2}$d. in 21 months?

12—If 100l. gain 4l. 10s. intereſt in 12 months, in what time will 347l. 15s. gain 17l. 4s. $5\frac{1}{2}$d.?

13—If a man travel 120 miles in 4 days when the days are 12 hours long, in how many days will he travel 960 miles when the days are 16 hours long?

14—If 26 cwt. be carried 50 miles for 18l. how far may 84 cwt. 3 qr. 14 lb. be carried for 56l. 10s.?

15—If 14 men reap 8 acres of corn in 6 days, how many acres will 30 men reap in 14 days?

16—How

Example.—If 4 men work 16 rods of ditching in 3 days, how many men will work 96 rods in 6 days?

R. D. M. R. D.
16 : 3 :: 4 : 96 : 6
R. D. M. R. D. M.
16 : 6 :: 4 : 96 : 3 : 12

The queſtion being ſtated by the foregoing method, I obſerve that the ſecond and fifth terms make an inverſe proportion, for more days will require fewer men, therefore I change them one for the other, as in the ſecond form of ſtating, then multiply and divide as before, the anſwer is 12 men, which correſponds with the former example.

Or you may work by the following rule—Becauſe the products of contrary cauſe and effect are equal—write all the terms of the firſt cauſe and the ſecond effects in one line or column, and the terms of the ſecond cauſe and firſt effects in another, then one line or column will have one term in it more than the other, the product of all thoſe terms will be the dividend, and the product of all the terms in the other line or column will be the diviſor; divide and the quotient will be the anſwer.

Example.

16—How many men will reap 68 acres 2 roods and 12 perches of corn in 14 days, when 14 men will reap 8 acres in 6 days?

17—If 7 oxen be at graſs 4 weeks for 1l. 8s. how many oxen may be in the ſame paſture 12 weeks for 19l. 8s.?

18—If 6 men mow 24 acres of graſs in 8 days, in how many days will 24 men mow 288 acres?

19—If 6 men mow 24 acres of graſs in 8 days, how many acres of graſs will 24 men mow in 24 days?

20—If 6 men mow 24 acres of graſs in 8 days, how men will mow 288 acres in 24 days?

21—If 14 men dig a trench 120 yards long, 4 feet wide and 3 feet deep in 6 days, how many men will dig another trench 840 yards long, 7 feet wide and 4 feet deep in 12 days?

22—If 7 men dig a trench 90 yards long, 4 feet wide and 2 feet deep in 6 days, what length of another trench 8 feet wide and 6 feet deep will 24 men dig in 30 days?

Example.—If 4 men build a wall 2 feet thick, 6 feet high and 21 yards long in 6 days, how many men will build a wall 3 feet thick, 9 feet high, and 189 yards long in 3 days at the ſame rate.

$$\begin{array}{lcl}\text{First Cauſe} & 4\times6\times3\times9\times189 & \text{Second Effects.}\\ \hline \text{Second Cauſe} & \times3\times2\times6\times21 & \text{First Effects.}\end{array}$$

Or thus,

First Cauſe	4 men		Second Cauſe
	6 days	3 days	
Second Effects	3 feet	2 feet	First Effects
	9 feet	6 feet	
	189 yards	21 yards	
	122472	756	

756) 122472 (162 Men.

Here 4 men and 6 days make the firſt cauſe, 3 feet thick, 9 feet high and 189 yards long are the ſecond effects, all which multiplied together make 122472 for the dividend; 3 days is the ſecond cauſe (the other term being wanting and required); 2 feet thick, 6 feet high and 21 yards long are the terms of the firſt effects, the product of which is 756 for the diviſor; then 122472 divided by 756 gives 162 men for the anſwer.

This operation may frequently be contracted or ſhortened by the following method.

23—If the four-penny white loaf weigh 3 lb. 4 oz. when wheat is at 12s. the buſhel, what ſhould the twelve-penny white loaf weigh when wheat is at 16s. the buſhel?

24—If 17 yards of cloth which is 26 inches wide coſt 3l. 15s. what will 36 yards of cloth of the ſame quality and 32 inches wide coſt?

25—If graſs for 14 oxen 6 weeks coſt 12 guineas, how many oxen may be kept in equally good paſturage 13 weeks for 52l. 13s.?

26—What muſt be paid for graſs for 27 oxen 13 weeks at the rate of 12 guineas for 14 oxen 6 weeks?

27—If 120 ſtones, each a foot ſquare, will pave a court, how many ſtones 9 inches long and 6 inches broad would pave the ſame?

28—If 840 ſtones, each 3 feet long and 2 feet broad, will pave an area, how many ſtones which are 18 inches long and 9 inches broad will pave the ſame?

29—A hay mow 7 yards long $3\frac{1}{2}$ yards broad and 4 yards high was ſold for 22l. 1s. and if another mow of the ſame kind of hay be 12 yards long $7\frac{1}{2}$ yards broad and $3\frac{3}{4}$ yards high be valued by the former, what will it come to?

30—If

If you can find one term, or the product of two terms in one line or column equal to one term, or the product of two terms in the other, you may cancel them all; and if you can find one term in each line or column which can be divided by one and the ſame number without a remainder, you may cancel them both, and put the quotients inſtead thereof; as,

$$\frac{\overset{2}{4}\times6\times3\times9\times\overset{9}{189}}{\times3\times2\times6\times\ 21} = \frac{9\times9\times2}{1\times1} = 162 \text{ Men.}$$

Here 3 in each are cancelled, 6 in each line may be cancelled, 2 and 4 may both be divided by 2, therefore cancel 4 and 2, and ſupply their places with 2 and 1; then 189 and 21 may both be divided by 21, therefore cancel both, and ſupply their places with their quotients reſpectively, and we have only 9, 9, and 2 left in one line, and only units in the other (which do not multiply and therefore may be omitted, ſo the product of $9\times9\times2$ is 162 for the anſwer.

30—If a rectangled field 860 yards long and 120 yards broad be worth 40l. per acre, what length of another field 210 yards broad and which is worth but 28l. per acre, ſhould be given for the former?

31—If an iron bar 2 feet long, 3 inches broad, and 1 inch thick weigh 18 lb. what will be the weight of another bar 7 feet long, 6 inches broad, and 3½ inches thick?

32—If 14l. worth of wine, when it is valued at 40l. per ton, be ſufficient for 8 perſons 36 weeks, how much in value will ſuffice 30 perſons the whole year at 60l. per ton?

33—If the flooring of a room which is 7 yards long and 4½ yards broad coſt 2l. 6s. 6d. what will be the expence of flooring another room in the ſame manner when it is 9 yards long and 6¾ yards broad?

34—How many men will build a wall 240 yards long, 6 feet high and 3 feet thick in 8 days, when 7 men can build another 40 yards long, 4 feet high and 2 feet thick in 32 days?

PRACTICE.

THE rules of Practice are expeditious methods of calculating the value of any number of yards, pounds, hundred weights, &c. by having the price of one given; and this is done by taking aliquot or even parts, as in the following rules.

CASE I.

If the price be the aliquot or even part of a ſhilling, the like part of the quantity will be the anſwer in ſhillings *.

The

```
        |  746 yds. at 4d. per.
        |  ———
4d. ⅓   |  248   8
     £.  12  8   8   Anſwer.
```

* 746 yards at 4d. each will coſt 746 four-pences, which are reduced to ſhillings by 3, or taking ⅓d. thereof for ſhillings, the remainder is four-pences, which may be multiplied by 12 and divided again by 3 for pence, as in compound diviſion—The ſhillings are reduced to pounds by 20.

Work

The even parts of a Shilling.

6 pence is	$\frac{1}{2}$
4 ————	$\frac{1}{3}$
3 ————	$\frac{1}{4}$
2 ————	$\frac{1}{6}$
1$\frac{1}{2}$ ————	$\frac{1}{8}$
1 ————	$\frac{1}{12}$

EXAMPLE.

1—What will 327 yards come to at 6d. 4d. 3d. 2d. 1$\frac{1}{2}$d. and 1d. per yard?

II.

If you can take ſeveral ſuch parts, and parts of parts of a ſhilling that their ſum will be the price, then the like parts of the quantity will be the anſwer in ſhillings.

EXAMPLES.

2—What will 278 cwt. come to at 9d. 7d. 11d. 10d. and at 8$\frac{1}{2}$d. per cwt.?

3—What will 678 lbs. come to at 3$\frac{3}{4}$d. 8$\frac{3}{4}$d. 9$\frac{3}{4}$, 10$\frac{3}{4}$d. and at 11$\frac{3}{4}$d. per lb.?

III.

If the price be leſs than a penny, you may take parts of

---

	437 yards at 7d. per.
6 $\frac{1}{2}$	218 6
1d. $\frac{1}{6}$	36 5
	254 11
£.	12 14 11 Anſwer.

Work as before for 6d., and 1d. is one twelfth of a ſhilling or one ſixth of ſix-pence, therefore one twelfth of the quantity or one ſixth of the price at 6d. added to the price at 6d. make the anſwer.

	247 yards at $\frac{1}{3}$d. per.
$\frac{1}{3}$d. $\frac{1}{3}$	
1d. $\frac{1}{12}$	)82$\frac{1}{3}$
	6 10$\frac{1}{3}$ Anſwer.

The number of yards at $\frac{1}{3}$d. of a penny make ſo many pence when divided by 3.

746 yards

of a penny or of ſome number of pence, and reduce the reſult to ſhillings.

EXAMPLES.

4—What will 789 yards come to at 0½d. 0¼d. and at 0¾d. per yard?

5—What will 2745 yards coſt at 1, 3, 5, and 7 half farthings per yard?

IV.

If the price be leſs than a ſhilling, or exceed it by the aliquot part of a ſhilling, you may ſubtract ſuch part of the quantity from the quantity, or add to it the quantity, for the anſwer in ſhillings.

EXAMPLES.

6—What will 327 yards coſt at 9d. 8d. 10½d. and at 11d. per yard?

7—What will 349 lbs. come to at 1s. 2d., 1s. 3d., 1s. 4d. and 1s. 6d. per lb.?

8—What will 763 cwt. come to at 22d. 23½d. 1s. 7¾d. and at 1s. 10¼d. per cwt.?

V.

If the price be ſhillings and pence, you may multiply by the ſhillings, and take the parts as before for the pence, the ſum will be the anſwer in ſhillings.

EXAMPLE.

	746 yards at 3s. 4d. per.			
	3			
4d. $\frac{1}{3}$	2238			
	248	8		
	2486	8		
£.	124	6	8	Anſwer.

The number of yards multiplied by 3s. gives the ſhillings they will coſt at 3s. per yard, and 4d. per the number of yards divided by 3 reduces them to ſhillings, the ſum is the anſwer.

EXAMPLE.

9—What will 328 yards coſt at 3s. 4d., 7s. 9d., 15s. 8d. and at 16s. $10\frac{1}{2}$d. per yard?

VI.

If the price be an even number of ſhillings only, you may multiply by half their number, and double the units figure of the product for ſhillings, the reſt will be pounds.

EXAMPLES.

10—What will 276 yards come to at 6s. per yard?
11—What will 347 cwt. come to at 4s. 8s. 10s. 12s. 16s. and at 20s. per cwt.?
12—What will 286 ells come to at 24s. 36s. and at 50s. per ell?

VII.

If the price be an odd number of ſhillings, you may work as before for the greateſt even number, and take one

---

246 yards at 6s per.
3
£. 73 16

To muultiply by 3 and divide by 10 is the ſame as to multiply by 6 and divide by 20, wherefore the units figure muſt be doubled for ſhillings.

246 yards at 7s. per.
3
1s. $\frac{1}{20}$ | 73 16
12 6
£. 86 2

The price at 6s. is found as before, and 1s. the quantity will be ſhillings, which are reduced to pounds by 20; the ſum of theſe prices is the anſwer.

48 yards at 7s. 9d. per.
is 93 at 4s.
2
£.18 12 Anſwer.

48 yards at 7s. 9d. or 93d. is the ſame as 93 at 48d. or 4s. thus the price may be changed for the quantity and the quantity for the price in any of the caſes, when it will render the operation ſhorter or more convenient.

one twentieth of the given quantity for the odd ſhilling, the ſum will be the anſwer.

EXAMPLES.

13—What will 195 yards come to at 7s. per yard?
14—What will 369 lbs. come to at 9s. 11s. 17s. 23s. and at 37s. per lb.?

VIII.

If the price he an odd number of ſhillings and ſome pence, work as before for the ſhillings, and take parts of the odd ſhilling for the pence, the ſum will be the anſwer.

EXAMPLES.

15—What will 273 yards come to at 5s. 6d. per yard?
16—What will 347 yards come to at 7s. 9d., 13s. 10½d., 17s. 11d., and at 23s. 5¼d.?

If

---

176 yards at 5s. 9d. per.

		2	
		35	4
1	$\frac{1}{20}$	8	16
6	$\frac{1}{2}$	4	8
3	$\frac{1}{2}$	2	4
£.		50	12 Anſwer.

The 4s. worked for as before, and 1s. is the twentieth of a pound, 6d. is one half of a ſhilling, and 3d. is half of ſix-pence; the ſum of thoſe parts is the anſwer.

247 yards at 12s. 6d. per.

10s.	$\frac{1}{2}$	123	10s.	
2s. 6d.	$\frac{1}{4}$	30	17	6d.
£.		154	7	6. Anſwer.

10s. is half a pound, therefore any number of yards at 10s. will coſt half as many pounds, and at 2s. 6d. one fourth as much as at 10s. the ſum of thoſe parts is the anſwer.

46½ yards

IX.

If the price be the even part of a pound, the like part of the quantity will be the anſwer in pounds.

The even parts of a Pound.

10s	is	$\frac{1}{2}$ of a pound.
6 8d.		$\frac{1}{3}$
5		$\frac{1}{4}$
4		$\frac{1}{5}$
3 4		$\frac{1}{6}$
2 6		$\frac{1}{8}$
2		$\frac{1}{10}$
1		$\frac{1}{20}$

EXAMPLES.

17—What will 476 yards come to at 10s. per yard?

18—What

---

247 yards at 2l. 15s. per.

		2	
10s.	$\frac{1}{2}$	494	
5	$\frac{1}{2}$	123	10
		61	15
£.		669	5 Anſwer.

Multiply by the pounds, and take parts of the quantity or parts of parts for the ſhillings and pence; the ſum is the anſwer as in the work.

46¾ yards at 3l. 14s. 6d. per.

		3		
10s.	$\frac{1}{2}$	138		
4	$\frac{1}{5}$	23		
0 6	$\frac{1}{8}$	9	4	
$\frac{1}{2}$ yd.		1	3	
$\frac{1}{4}$		1	17	3
		0	18	7½
£.		174	3	10½ Anſwer.

Find the value of 46 yards as in former caſes, then for the half yard take half the given price, and for the quarter of a yard take quarter of the price; the ſum is the anſwer as in the work.

67 yards

18—What will 327 yards come to at 6s. 8d., 5s. 4s. 3s. 4d. 2s. 6d., 2s. and at 1s. per yard?

X.

If you can take ſeveral ſuch parts, or parts of parts of a pound, that their ſum will be the price, then the ſum of the like parts of the quantity will be the anſwer in pounds.

EXAMPLES.

19—What will 327 yards come to at 15s. per yard?
20—What will 196 yards come to at 17s. 6d., 18s. 6d. 13s. 4d., 17s. 9d., 12s. 10d., and at 18s. 11d. per yard?

XI.

If the price be pounds ſhillings and pence, you may multiply by the pounds, and work by the foregoing rules for the ſhillings and pence.

```
           67 cwt. 1 qr. 14 lb. at 18s. 4d.
              |  ____
10s.    1/2   |  33  10
 5      1/2   |  16  15
 3 4    1/6   |  11   3   4
 1 qr.  1/4   |   0   4   7
14lb.   1/2   |   0   2   3½
              |  ______________
           £.61  15   2½  Anſwer.
```

One quarter will coſt one quarter of the price of one hundred wt. and 14 lb. will coſt half as much as a quarter.

```
             | 68⅗  at     16   8
             | ____
             |                  3
10s.   1/2   | 34           _______
 6 8   1/3   | 22  13   4  5)50  0
 ⅗ yd.       |  0  10   0    ____
             | ___________     10
          £.57   3   4   Ans.
```

The value of three fifths of a yard is three fifths of the price of a yard, therefore multiply by 3 and divide by 5. When the quantity is ſmall it is often convenient to multiply the price by the whole quantity, or by the integral part thereof, and take parts, &c. for the fraction or leſſer parts.

EXAMPLES.

21—What will 326 yards come to at 2l. 16s. 8d. per yard?

22—What will 349 yards come to at 1l. 14s. 8d. at 3l. 14s. 9d. and at 5l. 7s. 8d. per yard?

23—What will 178 yards come to at 14l. 3s. 9d. at 7l. 17s. 7d. and at 12l. 19s. 10d. per yard?

XII.

If the quantity have a fraction or ſome leſſer parts of weight, meaſure, &c. work for the whole number by the preceding rules, and take parts of the given price for the fraction, the ſum will be the anſwer.

EXAMPLES.

24—What will $27\frac{1}{2}$ cwt. come to at 2l. 14s. 6d. per cwt.?

25—What will $326\frac{3}{4}$ yards come to at 17s. 9d. per yd.?

26—What will $148\frac{1}{4}$ yards come to at 2l. 15s. 10d. per yard?

27—What

If 7 yards coſt 12s. what will 15 yards coſt?

```
    y.   s.     y.
as  7 : 12 :: 15
    2    2
   ———  ———
1/7)14  )24
    1    1  8 4/7
   ———  —————
    15 £.1  5  8 1/2
```

Becauſe twice the firſt term and one ſeventh thereof make the third, twice the price of the firſt and one ſeventh thereof will make the price of the third.

If 8 yards coſt 28s. what will 93 yards coſt?

```
    y.   s.    y.
as  8 : 28 :: 93
    3          3
   ———       ———
    24      )279
1/2) 4   1/2) 46   6
   ———      ————————
    28      325    6
             16  5 6
```

Becauſe three times the firſt term and one half of the firſt make the ſecond, three times the third and half the third make the anſwer in ſhillings, which may be reduced to pounds as in the example.

27—What will 328 cwt. 3 qr. 14 lb. come to at 7l. 13s. 7d. per cwt.?

28—What will $184\frac{5}{8}$ yards come to at 37s. 10d. per yd.?

29—What will 87 cwt. 1 qr. 17 lb. come to at 7l. 3s. $10\frac{1}{2}$d. per cwt.?

30—What will 43 lb. 14 oz. come to at 7s. 8d. per lb.?

31—What will 125 yards, 3 qr. 2 nails come to at 23s. 6d. per yard?

Sometimes the price may be changed for the quantity, and the quantity for the price.

EXAMPLES.

32—What will 48 yards come to at 3s. 7d., 4s. $2\frac{1}{2}$d., and at 7s. 8d. per yard?

33—What will 72 yards come to at 14s. 7d., 7s. $11\frac{1}{2}$d. and at 13s. $2\frac{1}{2}$d. per yard?

34—What will 78 yards come to at 7s. 10d., 4s. 11d. and at 5s. $8\frac{1}{2}$d. per yard?

Queſtions in the Rule of Three may ſometimes be worked by Practice.

If you can take ſuch parts of the firſt term that their ſum will be the ſecond, then the ſum of the like parts of the third will be the anſwer.

Or, if you can take ſuch parts of the firſt term that their ſum will be the third, then the ſum of the like parts of the ſecond will be the anſwer.

EXAMPLES.

35—If 6 yards of cloth coſt 21s. what will 5 yards coſt?

36—If 8 yards of cloth coſt 2l. 5s. what will 22 yards of the ſame coſt?

37—If 12 yards of cloth coſt 2l. 17s. what will 147 yards coſt?

38—If 16 yards of cloth coſt 5l. 7s. 6d. what will 60 yards coſt?

QUESTIONS

to exercise the foregoing

RULES IN PRACTICE.

1—What will $27\frac{1}{2}$ yards come to at 17s. $11\frac{1}{2}$d per yd.?

2—What will 34 cwt. coſt at 2l. 17s. $4\frac{1}{2}$d. per cwt.?

3—What 374 yards come to at 18s. $5\frac{3}{4}$d. per yard?

4—What will 111 cwt. come to at 6s. 8d. per cwt.?

5—What will 137 yards come to at 17s. per yard?

6—What will 411 cwt. come to at 24s. per cwt.?

7—What will 336 lb. coſt at 8s., 1s. 4d., 9s. and a 1s. 3d. per lb.?

8—What will 7496 yards come to at $\frac{3}{8}$ of a penny per yard?

9—What will 134 yards coſt at $7\frac{1}{2}$d. $10\frac{1}{2}$d. and at $11\frac{1}{2}$d. per yard?

10—What will 648 cwt. come to at 4d. and at 3d. per cwt.?

11—What will 176 lb. coſt at 2d., 1s. 2d., 2s. 2d., 2l. 2s. 2d. and at 2l. 13s. 8d. per lb.?

12—What will $346\frac{3}{4}$ yards come to at 4d., 8d., 16d., 7s. 9d., 7l. 17s. 9d., and at 13s. $7\frac{3}{4}$d. per yard?

13—What will 1612 cwt. 1 qr. 20 lb. coſt at 2s. 6d., 13s. 9d., 27s. $8\frac{3}{4}$d., and at 3l. 4s. $3\frac{1}{2}$d. per cwt.?

14—What will $17\frac{7}{18}$ yards come to at 5s. 3d., 17s. 4d., 9s., 1l. 17s. 6d. and at $5\frac{3}{4}$d. per yard?

15—What will 24 yards coſt at 3s. 4d., 7s. $10\frac{1}{4}$d., 1s. $8\frac{1}{4}$d., and at 1l. 14s. 11d. per yard?

16—What will $17\frac{1}{2}$ lb. come to at $3\frac{1}{4}$d., 19s. 6d., 3l. 11s. $10\frac{1}{2}$d., and at 27l. 14s. 9d. per lb.?

17—What will 1004 yards come to at 1d., $0\frac{1}{2}$d., $0\frac{3}{8}$d., $0\frac{1}{8}$d., $0\frac{1}{5}$d., and at $0\frac{3}{5}$d. per yard?

18—What will 2076 lb. coſt at 2l. 17s. 11d., 14s. 10d., 28s. 6d., 3s. $8\frac{3}{4}$d., and at $5\frac{1}{4}$d. per lb.?

19—What will 378 cwt. come to at 47s. $11\frac{1}{4}$d., 14l. 6s. $7\frac{1}{2}$d., 3s. $8\frac{1}{4}$d., $11\frac{3}{4}$d., and at 11s. $11\frac{1}{4}$d. per cwt.?

20—What will 9 cwt. 1 qr. 24 lb. coſt at 7¾d., 17s. 7¾d., 1s. 10¾d., 32s. 1½d., and at 3l. 10s. 10½d. per cwt.?

21—What will 7lb. 14 oz. come to at 4s. 2d., 7s. 4d., 15s. 8d., 1l. 12s. 2½d., and at 4l. 3s. 11d. per lb.?

22—What will 147 ſheep coſt at 6s. 8d., 9s. 2d., 11s. 5d. 13s. 4d., 17s. 2d., and at 21s. 7½d. per ſheep?

23—What will 2143 ells come to at 2s. 7½d., 13s. 4¾d., 23s. 5¾d., and at 1l. 17s. 8¾d. per ell?

24—What will 3414 yards come to at 0¼d., 0¾d. 7s. 5¼d. 2l. 11s. 10¾d., and at 3l. 0s. 8½d. per yard?

Promiscuous Questions

in all the

FOREGOING RULES.

1—What is the ſum, difference, product and quotient of 468 and 5616?

2—What is the difference between 46 times 62l. 5s. 5d. and a 46th part of the ſame?

3—What will 437¾ yards of cloth come to at 1l. 17s. 9d. per yard?

4—If 346 yards of cloth coſt 195l. 17s. 6d. what is it per yard?

5—How much will 30¼ yards of cloth come to at 11¾d. per yard?

6—A man who has only 150l. 15s. 9d. owes to ſix perſons each 15l. 13s. 6½d. what will he have left when thoſe debts are paid?

7—What is the difference between 15 reams of paper at 30s. 3d. and 23 reams at 17s. 9d. per ream?

8—How much are buttons per dozen when 6 dozen coſt 14s. 6d.?

9—From the 11th part of 109l. 6s. 3d. take the 17th part of 91l. 19s. 0¾d.?

10—Whether is 42 times 6¾d. or 8 times 4s. 6¼d more, and how much?

11—Gave 5s. 3¼d. per yard for 109 yards of cloth, how much did the whole coſt?

12—If 3 men earn 2l. 15s in 6 days, how much will 12 men earn in 1 year?

13—If a hogſhead of ſugar coſt 28l. 7s. at the rate of 3l. 12s. per cwt. what did it weigh?

14—If a hogſhead of wine containing 63 gallons coſt 15l. carriage and porterage 15s. how muſt it be ſold per bottle and per gallon to gain 6 guineas by the hogſhead?

15—240l. is to be divided among 3 men, ſo that the firſt may have twice as much as the ſecond, and the ſecond twice as much as the third; what muſt each have?

16—If 16 pieces of muſlin coſt 56l. at 2s. 6d. per yard, how many yards are in each piece?

17—A man whoſe yearly income is 200l. lays by 33l. 15s. at the year's end; what does he ſpend per day?

18—A man ſold a horſe for 24l. and gained one third of what it coſt him; what did he give for the horſe?

19—A cloth manufacturer gave 24l. for a quantity of wool, the ſpinning, weaving, dreſſing and dying of which coſt him 20l. and he ſold the cloth at 5s. 3d. per yard, and gained 15l. by the whole; how many yards did he make of that parcel of wool?

20—A grocer bought 46 cwt. 3 qr. 14 lb. of ſugar for 3l. 5s. per cwt. and ſold it again at 7½d per lb. what did he gain by the whole?

21—A man has two debtors who together owe him 240l. 17s. 6d. but one owes him 64l. 10s. more than the other; what does each owe him?

22—A man ſold two pieces of cloth, each 28 yards, for 12 guineas, but one piece came to 2l. 4s. more than the other; what was each piece ſold for per yard?

23—A man has four debtors who together owe him 245l. but their particular ſums he has forgot, only he remembers that the firſt owes him as much as the ſecond and fourth, the third twice as much as the fourth, and the second as much as both the third and fourth; what does each owe him?

24—What will 26 cwt. 3 qr. 7 lb. of cheeſe come to at 43s. 9d. per cwt. and what is it per pound?

25—A perſon bought 233 pieces of cloth, each 29½ yds. at 22½d. per yard, and ſold them again at 2s. 3½d. per yard; what did he gain by the bargain?

26—What will 40 pices of cloth, each 28 yards, come to at 23½d. per yard?

27—What will 10 ells Engliſh and 10 ells Flemiſh come to at 3¼d. per nail?

28—A perſon bought 34 yards of cloth at 7s. 4½d. per yard, 17¾ yards at 8s. 2d. per yard, and 56¼ yards at 7s. 11¼d. per yard; what did the whole coſt him, and what per yard?

TARE AND TRETT.

THIS teaches to calculate and deduct the allowances made in the weight of goods *.

Groſs Weight is the weight of the whole package before any allowance or deduction is made.

Tare

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* Example.—In 46 cwt. 3 qr. 14 lb. groſs, tare 14 lb. per cwt. trett 4 lb. per 104, and cloff 2 lb. per 3 cwt. groſs; what is the neat weight?

		cwt.	*qr.*	*lb.*	
14lb.	⅛)	46	3	14	Groſs
		5	3	12¼	Tare
4lb.	1/26	40	3	1¾	Tare Suttle
		1	2	7½	Trett
		39	0	22¼	Trett Suttle
		0	1	3¼	Cloff
		38	3	19	Neat

	cwt.	*qr.*	*lb.*
	46	3	14
			2
3)	93	3	0
	31	1	0
	0	1	3¼

14 lb.

Tare is an allowance for the weight of the box, bag, cheſt, &c. wherein the goods are weighed—Sometimes the tare is given in the whole, then it is only to be ſubtracted from the groſs: ſometimes it is given at ſo much per caſk or other package, then the tare of one package muſt be multiplied by the number of ſuch packages for the whole tare to be ſubtracted. If it is at ſo much per cwt. it may be found by the Rule of Three, or the Rules of Practice, and then ſubtracted from the groſs; what is then left, if there is any other allowance, is called ſuttle, or tare ſuttle.

Trett is an allowance of 4 lb. at every 104 or $\frac{1}{26}$ part of the ſuttle to be ſubtracted from the ſuttle, on account of waſte, &c. what is left after the trett is ſubtracted is called trett ſuttle if any more allowance is to be made.

Cloff is an allowance of 2 lb. upon 3 cwt. groſs on account of duſt and other waſte.

Multiply the groſs by 2 and divide the product by 3, call the cwts. in the quotient pounds, every quarter 4 ounces, and every lb. $\frac{1}{7}$ of an ounce, or every 7 lb. one ounce.

Subtract the cloff from the trett ſuttle; the remainder is neat weight.

Neat Weight is what remains when all deductions are made, and is the weight charged.

EXAMPLES.

1—What is the neat weight of 56 barrels of anchovies, weighing

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14 lb. is $\frac{1}{8}$ of 1 cwt. therefore to allow 14 lb. per cwt. is to allow $\frac{1}{8}$ of the whole groſs for tare, which ſubtracted from the groſs leaves the tare ſuttle; and 4 lb. being $\frac{1}{26}$ of 104 lb. $\frac{1}{26}$ of the tare ſuttle is tret, which ſubtracted from the tare ſuttle leaves the trett ſuttle. Cloff being an allowance of 2 lb. upon every cwt. groſs, multiply the groſs weight by 2 and divide by 3, the cwts. in the quotient being called pounds may be reduced to quarters, &c. the quarters are quarters of pounds, and the pounds are each $\frac{1}{7}$ of an ounce, but it is not cuſtomary to reckon the cloff for any more than the 3 cwts.?

In this manner are the allowances made, and may be eaſily calculated according to the form in which they are given.

weighing in all 884 lb. groſs, allowing 8 lb. per cwt. tare?

2—What is the neat weight of 46 cwt. 3 qr. 14 lb. of ſugar groſs, when tare is 14 lb. per cwt.?

3—In 12 cwt. 0 qr. 14 lb. groſs, tare 1 cwt. 2 qr. 18 lb. what is neat weight?

4—What is the neat weight of 20 barrels of figs, each 3 cwt. 1 qr. 5 lb. groſs, tare 14 lb per barrel?

5—If the groſs weight of 4 caſks of ſugar be as follow, viz. 3 cwt. 2 qr. 14 lb., 5 cwt. 1 qr. 17 lb., 2 cwt. 3 qr. 18 lb., and 1 cwt. 3 qr. 26 lb. tare in the whole 1 cwt. 3 qr. 5 lb. what is the neat weight?

6—Suppoſe 5 caſks of raiſins to weigh as follow, viz.

		cwt.	*qr.*	*lb.*		*lb.*
No. 1	groſs weight	3	2	12	Tare	18
2	———	2	3	9	———	16
3	———	4	1	17	———	23
4	———	5	0	8	———	27
5	———	1	3	20	———	14

what is the neat weight?

7—In 3 cwt. 1 qr. 5 lb. groſs, tare 17 lb., trett 4 lb. per 104; what is the neat weight?

8—In 4 caſks weighing 29 cwt. 1 qr. 17 lb. groſs, tare 2 qr. 10 lb. per caſk, trett 4 lb. per 104, and cloff 2 lb. per 3 cwt. what is the neat weight?

9—In 17 cwt. 17 lb. groſs, tare 18 lb. per cwt. trett 4 lb. per 104, and cloff 2 lb. per 3 cwt. how much neat weight?

10—In 6 hogſheads of tobacco containing 56 cwt. 2 qr. 20 lb. groſs, tare 30 lb. per hogſhead, trett 4 lb. per 104, and cloff 2 lb. per 3 cwt. what will the neat weight come to at 7½d. per lb.?

BARTER.

BARTER teaches to exchange commodities or wares without loſs.

I. If both quantities and their prices are given, find their values by Multiplication, the Rule of Three or

Practice, and the difference of thoſe values will be the balance to be paid.

II. If both prices are given, and one quantity to find the other quantity,—ſay as the price is to the quantity, ſo is the price inverſely to the quantity: Or,

Find the value of the given quantity, and then find the quantity of the other which that value will purchaſe.

III. If both quantities and one price are given, ſay, as the quantity is to the price ſo is the quantity inverſely to the price: Or,

Find the value of that quantity which has the price given, which will alſo be the value of the other quantity, and which divided by the quantity will give the price; or the price may be found by the Rule of Three.

IV. If both quantities and prices are given, and the balance to be paid in a third kind or ſort of goods, firſt find the real balance, and then find the quantity that balance will purchaſe.

V. If the barter prices be different to the ready money prices, then as the ready money price of the one is to the bartering price thereof, ſo is the ready money price of the otherto the bartering price thereof, and vice verſa *.

1—How

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* Example.—How many yards of cloth at 3s. 6d. per yard muſt be given for 14 yards at 7s. per yard?

s. *y.* *s. d.* *y.*
7 : 14 :: 3 6 : 28

As the price is to the quantity ſo is the price to the quantity inverſely; for it is evident that leſs the price and bigger the quantity muſt be; and greater the price leſs the quantity muſt be.

But where the quantities are compound it will be cleareſt to work by two operations: as,

Example.—How many yards of cloth at 3s. per yard will pay for 14 cwt. 3 qr. 14 lb. of ſugar at 2l. 16s. per cwt?

cwt. *l.* *s.* *cwt.* *qr.* *lb.* *l.* *s.*
1 : 2 : 16 :: 14 : 3 : 14 : 41 : 13
s. *y.* *l.* *s.* *yds.*
3 : 1 :: 41 : 13 : $277\frac{1}{3}$

Or find the price of 14 cwt 3 qr. 14 lb. of ſugar by Practice, or any the moſt convenient method; and then the number of yards that money will purchaſe—the anſwer is $277\frac{1}{3}$ yards.

Example

EXAMPLES.

1—How much ſugar at 4½d. per lb. will purchaſe a puncheon of rum, value 15l. 10s.

2—How many pairs of ſtockings at 2s. 4d. per pair muſt be given for 46 yards of cloth at 8s. 9d. per yard?

3—How much inkle at 3 yards a penny will pay for 14 cwt. 3 qr. 14 lb of ſugar at 53s. 6d. per cwt.?

4—Two men, A and B, barter, A has 46 yards of kerſey at 2s. 9d, per yard, B has 16 dozen of handkerchiefs at 5s. 10d. per dozen, and they deſire to know whether muſt pay money, and how much?

5—A has 480 lb. of cotton wool at 15d. per lb. ready money, but in barter he will have 16½d. per lb. B has plain cloth at 5s. per yard ready money, and deſires to know how he muſt charge it in barter, and how many yards he muſt give for A's cotton wool?

6—If 24 cwt. of tobacco at 1l. 18s. per cwt. be given for 100 yards of cloth, what is the value of the cloth per yard?

7—If I give 37l. 16s. for 144 ducats, what is the value of a ducat?

8—A and B barter, A has 92 yards of broad cloth at 15s. per yard, for which B is to give him 120 gallons of rum at 9s. per gallon, and the reſt in Britiſh compounds at 3s. 9d. per gallon; how much compounds muſt A receive?

EXAMPLE.—If goods which are worth 3s. ready money be charged 3s. 6d. in barter, what muſt goods worth 9s. ready money be charged in bartering for the former?

s. *s.* *d.* *s.* *s.* *d.* Viz. if 3s. be advanced to 3s. 6d.
3 : 3 : 6 :: 9 : 10 : 6 what muſt 9s. be advanced to; for it is evident one muſt be advanced or augmented in proportion to the other.

Reaſon will ſupply every other conſideration in Barter.

LOSS

LOSS AND GAIN.

GAIN and Loſs are generally rated by the 100l. called per cent.

Queſtions in this rule are all anſwerable by the Rule of Three, which being well underſtood there needs no further direction: for,

As the coſt is to the gain thereby, ſo is 100l. to the gain per cent. or,

As the coſt is to the price ſold for, ſo is 100l. to the amount of 100l. from which ſubtract 100l. the remainder is the gain per cent.

As 100l. is to the gain per cent. added to 100l. ſo is the coſt to the price to be ſold for to allow ſuch gain.

As any gain per cent added to 100l. is to any other gain per cent. added to 100l. ſo is the price allowing the former gain, to the price allowing the latter gain *.

EXAMPLES.

1—If I buy yarn at 10d. per lb. and ſell it again at $12\frac{1}{2}$d. per lb. what do I gain per cent. ?

2—If I buy yarn at 10d. per lb. how muſt I ſell it per lb. to gain 25 per cent. ?

3—If

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* Example.—If I buy goods for 5s. which I ſell again for 5s. 6d. what do I gain per cent. ?

s. *s.* *d.* *l.* *l.*
as 5 : 5 6 :: 100 : 110
100
——
10 per cent.

or,

s. *d.* *l.* *l.*
5 : 6 :: 100 : 10 gain per cent.

As the coſt to the price ſold for, ſo is 100 to the amount of 100, from which take 100, there remains the gain per cent.

If the firſt and third term be in like names, the third and fourth will be in like terms.

Example.—If I buy cloth at 5s. per yard, what muſt I ſell it for per yard to gain 10 per cent. ?

l. *l.* *s.* *s.* *d.*
as 100 : 110 :: 5 : 5 6

As 100l. to the gain added to 100l. ſo is the price bought at to the price to be ſold for.

Example.

3—If I buy a hundred weight of tobacco for 6l. 4s. and ſell it again at 16½d. per lb. what do I gain or loſe per cent.?

4—If I buy a hundred weight of tobacco for 6l. 4s. what muſt I ſell it for per lb. to gain 24 per cent.?

5—If by ſelling cloth at 18s. per yard I gain 20 per cent. what did it coſt me?

6—If I gain 6 per cent. by ſelling cloth at 4s. 5d. per yard, what ſhall I gain per cent. if I ſell the ſame at 5s. 3d. per yard?

7—Sold cloth at 4s. 5d. per yard and gained 6 per cent. how muſt I ſell it per yard to gain 18 per cent.?

8—Bought a hundred weight of ſugar for 2l. 12s. which not proving ſo good as I expected, I am willing to loſe 8 per cent. how muſt I ſell it per lb.?

9—Sold cloth at 7s. 10d. per yard, and found that I loſt 6 per cent. thereby; what muſt I ſell the ſame cloth for to gain 18 per cent.?

10—How muſt I buy cloth to ſell at 10s. per yard and gain 20 per cent.?

Example.—If I gain 10 per cent. by ſelling cloth at 5s. 6d. per yard, what ſhall I gain per cent. by ſelling the ſame at 6s. per yard?

s. *d.* *s.* *l.* *l.*
5 : 6 : 6 :: 110 : 120
100
20 per cent.

If I buy 12 yards of cloth for 3l. and ſell it again at 6s. per yard, what do I gain per cent.?

y. *s.* *y.* *l.* *s.*
1 : 6 : 12 :: 3 : 12 the whole is ſold for.
l. *s.* *l.* *l.*
3 : 12 :: 100 : 20 gain per cent.

All which is ſo evident as to need no further illuſtration.

SIMPLE INTEREST.

WHEN no intereſt is allowed for intereſt unpaid, it is only Simple Intereſt.

Principal is the money lent.

Intereſt is what is paid for the loan of money.

Rate is the intereſt of 100l. for 1 year.

Amount is the ſum of both principal and intereſt.

Time is the number of years and parts of a year for which intereſt is reckoned.

RULE*.

When the principal, rate, and time are given to find the intereſt or the amount—Multiply the principal, rate, and time one into another, and divide the product by 100; the quotient will be the intereſt, which added to the principal makes the amount.

When the intereſt, rate, and time are given to find the principal—Multiply the rate by the time; the product is the intereſt of 100l. for that time;—then as that intereſt is to 100l. ſo is the given intereſt to the principal required.

Or,

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* EXAMPLE.—What will 246l. gain in 1 year at 5 per cent. ?

l. l. l. l. s.
as 100 : 5 :: 246 : 12 6
5
12)30
20
6)00

If 100l. gain 5l. what will 246l gain?—The operation is evident—5l. being one twentieth of 100l. one twentieth of the principal will be the intereſt.

EXAMPLE.—What will 246l. gain in 4 years at 5 per cent. per annum ?

l. 5 l. l. s.
4
100 : 20 :: 246 : 49 : 4

It is evident that if 100l. gain 5l in 1 year, it will 4 times 5 in 4 years, and if 100l. gain 20l. in a given time, what will 246l gain in the ſame time ? Hence the time, rate, and principal all multiplied together and divided by 100 give the intereſt.

If

Or, as the ſaid intereſt of 100l. added to 100l. is to 100l. ſo is the amount to the principal required.

When the principal, rate, and amount are given to find the time, multiply the principal by the rate, and divide by 100, the quotient is the intereſt for 1 year, by which divide the whole intereſt—the quotient is the time.

When the principal, time, and intereſt, or amount, are given to find the rate—The difference between the principal and the amount is the intereſt, which divided by the time gives the intereſt for one year; and as the principal to the intereſt thereof for one year, ſo is 100l. to the rate per cent.

EXAMPLES.

1—What intereſt will 246l. 10s. gain in one year at 5 per cent. per annum, ſimple intereſt?

2—What will 246l. 10s. gain in 7 years at 5 per cent. per annum, ſimple intereſt?

3—What

If the amount had been required, add the intereſt to the principal, the ſum will be the amount; viz. 49l. 4s. added to 246l. makes 295l. 4s. for the amount. Or if you add 100l. to the intereſt of 100l. it will give the amount of 100l. and the proportion would then be as 100l. to the amount thereof; ſo is the given principal to the amount: thus, as 100l. : 120l. :: 246l. : 295l. 4s. as before.

When the intereſt is 5 per cent. per annum, it is 1s. per pound per year, and 1d. per month, and ¼d. per week nearly.

EXAMPLE.—What will 327l. 17s. 6d. gain in 3 years and 5 months at 5 per cent. per annum?

l.	*s.*	*d.*		*l*	*s.*	*d.*
327	17	6		327	17	6
		3				5
20)983	12	6		1639	7	6
49	3	7½		136	7¼	
9	16	7¼				
				6	16	7¼
56	0	2¾				

Multiply by the years and call the pounds ſhillings, and take parts of 1 ſhilling for the ſhillings and pence; or divide the whole by 20. Multiply the principal by the months, and call the pounds pence, and take parts for the ſhillings and pence—the ſum of theſe reſults will be the intereſt required, as in the example.

If

3—What will 340l. amount to in 12 years at 5 per cent. per annum, ſimple intereſt?

4—What intereſt will 720l. gain in 4½ years at 4 per cent. per annum?

5—What ſum of money will amount to 52l. 18s. in 3 years at 5 per cent. per annum, ſimple intereſt?

6—What ſum of money will gain 129l. 12s. in 4½ years at 4 per cent. per annum, ſimple intereſt?

7—In what time will 184l. amount to 248l. 8s. at the rate of 5 per cent. per annum, ſimple intereſt?

8—In what time will 240l. gain 48l. 9s. at the rate of 4l. 5s. per cent. per annum, ſimple intereſt?

9—At what rate of ſimple intereſt will 46l. amount to 55l. 4s. in 4 years?

10—What intereſt will 145l. 16s. gain in 4¾ years at 5 per cent. per annum?

11—What ſum of money will gain 13l. 16s. ſimple intereſt, in 6 years at 5 per cent. per annum?

12—In what time will 340l. amount to 432l. 4s. 6d. at the rate of 3l. 10s. per cent. per annum, ſimple intereſt?

13—At what rate of ſimple intereſt will 240l. amount to 304l. 16s. in 6 years?

14—What

$$\begin{array}{c|rrr} \frac{1}{10} & 56 & 0 & 2\frac{3}{4} \\ & 5 & 12 & 0\frac{1}{4} \\ \cline{2-4} & 50 & 8 & 2\frac{1}{2} \end{array}$$

If the intereſt be more or leſs than 5 per cent. you may work as before for 5 per cent. and add or ſubtract ſuch part thereof as it exceeds or is leſs than 5 per cent.: ſo in the foregoing example, if the rate had been 4½ per cent. find the intereſt for 5 per cent. one tenth of which ſubtracted therefrom leaves the intereſt at 4½ per cent.; and ſo for any other.

Example.—What ſum of money will amount to 24l. in 4 years, at 5 per cent. per annum, ſimple intereſt?

$$\begin{array}{r} 5 \\ 4 \\ \hline 20 \\ 100 \\ \hline \end{array}$$

5l. the yearly intereſt of 100l. multiplied by 4, gives the intereſt of 100l. for 4 years, which added to 100l. makes the amount of 100 for 4 years; then, as that amount is to 100l. the principal, ſo is 24 the given amount to the principal required.

120*l.* : 100*l.* :: 24*l* : 20*l.*

Example.

14—What intereſt will 720l. gain in 4 years at 4½ per cent. per annum, ſimple intereſt?

15—What intereſt will 345l. 10s. gain in 7 years and 7 months, at 4¼ per cent. per annum?

16—What ſum of money will amount to 130l. 19s. in 9¾ years at 4l. 15s. per cent. per annum, ſimple intereſt?

17—What ſum of money will amount 542l. 2s. in 1 year at 4¼ per cent.?

18—What is the ſimple intereſt of 480l. 17s. 6d. for 1 year at 5 per cent. per annum?

19—What is the intereſt of 327l. 14s. for 7½ months at 5 per cent. per annum, ſimple intereſt?

20—What will 346l. 18s. amount to in 3 years, 5 months and 10 days at 4½ per cent. ſimple intereſt?

COMMISSION, BROKERAGE, INSURANCE, &c.

Are all rated by the 100l. and therefore are reckoned as ſimple intereſt for 1 year.

EXAMPLES.

21—What is the commiſſion on the ſales of goods to the amount of 246l. 10s. at 5 per cent.?

22—A factor bought goods for his employer to the

EXAMPLE.—In what time will 20l. amount to 24l. at 5 per cent. ſimple intereſt?

l. *l.* *l.* *l.* 24
100 : 5 :: 20 : 1 20
l. *y.* *l.* *y.* ——
1 : 1 :: 4 : 4 4

As 100l. to 5l. the intereſt thereof, ſo is 20l. to 1l. the intereſt thereof for 1 year, by which divide the whole intereſt, the quotient is the time.

EXAMPLE.—At what rate of ſimple intereſt will 20l. amount to 24l. in 4 years?

l. *l.* *l.* *l.*
as 20 : 4 :: 100 : 20
41) 20(5 per cent.

As 20l. to 4l. the intereſt thereof, ſo is 100l. to the intereſt which 100l. would gain in the ſame time, which divided by 4 the time, gives the rate: or, as the time to the intereſt for that time, ſo is 1 year to the intereſt for 1 year, which is the rate per cent.

amount of 967l. 15s. on which he charges $2\frac{1}{2}$ per cent. commiſſion; what does his charge amount to?

23—What does the inſurance of a ſhip and cargo, value 8426l. come to at $1\frac{3}{4}$ per cent.?

24—What does the inſurance of a ſhip valued at 3416l. 10s. come to at 2l. 3s. 4d. per cent.?

25—A factor bought goods to the value of 347l. 14s. 6d. and charges $2\frac{1}{2}$ per cent. commiſſion; what will be the amount of his invoice?

REBATE OR DISCOUNT *

Is an allowance or abatement for the payment of money before the time it becomes due.

The uſual method of reckoning this is as intereſt becoming due, viz. as 100l. to the intereſt thereof for the given time, ſo is the ſum to be diſcounted to the diſcount required.

Otherwiſe it may be reckoned by finding the preſent worth of the given ſum due at the given time, as in ſimple intereſt. The preſent worth ſubtracted from the amount leaves the diſcount. The diſcount ſubtracted from the amount leaves the preſent worth.

EXAMPLES.

26—What is the diſcount on 640l. 10s. due at 1 year, reckoning intereſt at 5 per cent. per annum?

27—What is the rebate and preſent worth of 247l. 10s. due in $2\frac{3}{4}$ years, intereſt being 5 per cent. per annum?

28—What is the diſcount on a bill for 126l. due in 3 months, allowing intereſt at 8 per cent. per annum?

29—What is the diſcount on 426l. 10s. due in 2 months and 12 days, at 5 per cent. per annum?

COMPOUND

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* EXAMPLE.—What is the commiſſion on ſales to the amount of 460l. at $2\frac{1}{2}$ per cent.?

l. l. l. l. s.
as 100 : $2\frac{1}{2}$ :: 460 : 11 10

Viz. as 100l. to the rate, ſo is the given ſum to the commiſſion thereon; which proportion may be worked by taking parts, &c. and ſo for any other.

COMPOUND INTEREST.

WHEN intereſt is paid for intereſt remaining in the borrower's hands, ſuch is called Compound Intereſt.

This is eaſier calculated by decimals, and ſtill much eaſier by the help of logarithms.

A TABLE of the Amount of 100000l. for 10 Years.

years	3 pr cent	3½ pr cent	4 pr cent	4¼ pr cent	4½ pr cent	4¾ pr cent	5 pr cent
¼	100741	100863	100986	101046	101106	101166	101227
½	101488	101735	101980	102103	102225	102247	102469
¾	102242	102914	102985	103171	103356	103541	103727
1	103000	103500	104000	104250	104500	104750	105000
2	106081	107122	108160	108680	109202	109723	110250
3	109272	110872	112487	113299	114114	114937	115762
4	112551	114753	116983	118114	119252	120397	121551
5	115927	118769	121665	123134	124618	126116	127628
6	119405	122925	126532	128664	130223	132106	134010
7	122987	127227	131593	133824	136086	138382	140710
8	126674	131681	136857	139511	142210	144554	147745
9	130476	136289	142331	145440	148610	151840	155132
10	134392	141060	148027	151625	155297	159052	162890

The principal, time, and rate given to find the amount.

Find the intereſt for 1 year as in ſimple intereſt, which added to the principal gives the firſt year's amount; make that ſum the principal and find its amount for 1 year, and ſo on till you have calculated for as many years as make the time required—The laſt amount will be that required; from which if you ſubtract the firſt principal the remainder will be the compound intereſt.

Or, multiply the principal by the amount of 100000l. for the time and at the rate given, as found in the table, divide the product by 100000, the quotient will be the amount; and if the time exceed the limits of the table, work for the whole years in the table, and then find what that amount will amount to in the remaining time *.

EXAMPLES.

1—What will 240l. amount to in 3 years at 5 per cent. per annum, compound intereſt?

2—What is the compound intereſt of 146l. 10s. for 5 years at 4 per cent.?

3—What will 346l. 10s. amount to in 6½ years at 4½ per cent. compound intereſt?

The

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* EXAMPLE.—What will 800l. amount to in 4 years at 5 per cent. per annum, compound intereſt?

Principal	800		
1ſt. year's intereſt	40		
1ſt. year's amount	840		
2d. yr's intereſt for do	42		
2d. year's amount	882		
3d. year's intereſt	44	2	
3d. year's amount	926	2	
4th. year's intereſt	46	6	1¾
4th. year's amount	972	8	1¾

The intereſt of 800l. for 1 year at 5 per cent. is 40l. which added to 800l. makes 840l. the firſt year's amount, which is a principal for the ſecond year, and the intereſt thereof is 42l. which added to 840l. makes 882l. the ſecond year's amount, and the thirdyear's principal; thus proceeding for every year—the fourth year's amount is 972l. 8s. 1¾d. very near: and if the intereſt or total gain had been required only, take 800l. from 972l. 8s. 1¾d. there will remain 172l. 8s. 1¾d. the compound intereſt required.

Or, in the table the amount of 100000l. for 4 years at 5 per cent. is 121551, then by the Rule of Three as 100000l to 121551 its amount, ſo is 800l. to 972l. 8s. 1¾d. the amount required.

EXAMPLE.

The amount, rate and time given to find the principal.

Find the amount of 100l. for the given time and at the given rate; then ſay, as that amount is to 100l. ſo is the given amount to the required principal.

Or, ſay as 100l. with the rate per cent. added is to 100l. ſo is the given amount to a principal which would give that amount in 1 year; repeat this operation as many times as there are years, and if there be a part of a year, add the intereſt of 100l. for that time to 100l. for the firſt term, and the proportion worked will give the anſwer.

Or, find the amount of 100000l. in the table for the given time at the given rate, and ſay, as that amount is to 100000 ſo is the given amount to the required principal.

EXAMPLES.

4—What ſum of money will amount to 277l. 16s 7d. in 3 years at 5 per cent. per annum, compound intereſt?

5—What ſum will gain 31l. 14s. 9¾d., compound intereſt, in 5 years at 4 per cent. per annum?

6—What ſum of money will amount to 460l. 12s. 7½d. in 6½ years, at 4½ per cent. per annum, compound intereſt?

Principal,

EXAMPLE.—What ſum of money will amount to 972l. 8s. 1¾d. in 4 years at 5 per cent. per annum, compound intereſt?

By the table the amount of 100000l. is 121551l. therefore as 121551 the amount to 100000 the principal, ſo is 972l. 8s. 1¾d. the given amount to 800l. the principal required.

Or, find the amount of 100l. or any other ſum for the given time, at the given rate, as in the firſt caſe; then ſay, as that amount to its principal, ſo is the given amount to the required principal.

EXAMPLE.—In what time will 800l. amount to 972l. 8s. 1¾d. at 5 per cent. per annum, compound intereſt?

Work for the amount as in the firſt example, and the number of operations 4 is the time: but if it does not anſwer to even years, when you have found the time to within 1 year, ſubtract that amount from the given amount; alſo find what the next year's intereſt would be, and ſay, as that intereſt is to 1 year, ſo is the aforeſaid remainder to the part of a year wanting.

Or,

Principal, rate and amount given to find the time.

Find the amount of the given principal for one year, and of that ſum for another, and ſo on continually till you find the given amount, then the time will be known by the number of operations.

Or, multiply the amount by 100000, and divide the product by the rate, the quotient found in the table under the rate will ſtand againſt the time

EXAMPLES.

7—In what time will 240l. amount to 277l. 16s. 7d. at 5 per cent. per annum, compound intereſt?

8—In what time will 146l. 10s. gain 31l. 14s. 9¾d., compound intereſt, at 4 per cent. per annum?

9—In what time will 346l. 10s. amount to 460l. 12s. 7½d. at 4½ per cent. per annum, compound intereſt?

Principal, time, and amount given to find the rate.

Work as in the laſt rule, and the quotient found in the table againſt the time will be under the rate.

10—At what rate of compound intereſt will 240l. amount to 277l. 16s. 7d. in 3 years?

11—At what rate per cent. will 146l. 10s. gain 31l. 14s. 9¾d. in 5 years, compound intereſt?

12—If 346l. 10s. amount to 460l. 12s. 7½d. in 6½ years, what was the rate per cent.?

ANNUITIES.

Annuity is the yearly payment of a certain ſum.

To find a principal, the intereſt whereof will be the given annuity.

As

Or, work by the table according to rule which will find either the time or rate.

ANNUITIES.

EXAMPLE.—What will an annuity of 20l. amount to forborn 6 years, at 5 per cent. per annum, compound intereſt?

as 5l. : 100l. :: 20l. : 400l. Then the compound intereſt of 400l. for 6 years at 5 per cent. will be found to be 136l. 0s. 9½d. which is the amount of the annuity.

As the rate per cent. is to 100l. ſo is the given annuity to the principal, the intereſt whereof will pay that annuity; then the compound intereſt of that principal will be the amount of the annuity.

EXAMPLES.

13—What will an annuity of 45l. per annum amount to in 9 years at 5 per cent. per annum, compound intereſt?

14—What is the preſent worth of an annuity of 20l. per annum, to continue 8 years at 5 per cent. per annum, compound intereſt?

15—A perſon received 400l. on condition of returning 50l. a year for 10 years, whether did he gain or loſe thereby, allowing 5 per cent. for the money?

16—What muſt I give for an eſtate of 50l. a year, ſubject to an annuity of 30l. a year for 12 years to come, ſo that the eſtate may make me 4 per cent.?

EXCHANGE.

EXCHANGE, among merchants, is a trade in money carried on between one place and another by means of bills of exchange.

Par of exchange is the certain intrinſic value of foreign money compared with ſterling.

Courſe of exchange is the variable value of foreign money compared with ſterling, which is ſometimes above and ſometimes below par.

Foreign bank money is finer than their current money, and their difference of value is called agio.

Ireland, America, and the Weſt Indies keep their accounts in pounds, ſhillings and pence, as in England.

Holland, Flanders and Germany ſometimes keep their accounts in pounds, ſhillings and pence, and ſometimes in the following

FLEMISH.

FLEMISH.

16 pennings ——1 ſtiver.
20 ſtivers ——1 guilder or florin.
12 pennings ——1 lubiſh ſhilling.
16 lubiſh ſhillings ——1 mark.
8 pennings ——1 grote or penny.
12 grotes or pence ——1 ſkilling.
20 ſkillings ——1 pound.
6 phennings ——1 grote Flemiſh.
6 lubiſh ſhillings ——1 ſkilling
7½ lubiſh marks ——1 pound
20 florins ——1 ducat or ducatoon
15 florins ——1 ſovereign
11 florins ——1 roſe noble
63 ſtivers ——1 ducatoon
60 ſtivers ——1 dric gulden
50 ſtivers ——1 rix dollar
40 ſtivers ——1 crown
30 ſtivers ——1 dollar
28 ſtivers ——1 guild florin
6 ſtivers ——1 ſchilling
2 grotes ——1 ſtiver
copper

FRANCE exchange at 4s. 6d. per ecu at par.

12 deniers ——1 ſol or ſou
20 ſols ——1 livre
3 livres ——1 crown
4 liards (copper)——1 ſol
20 ſols (braſs) ——1 liard
6 livers (ſilver) ——1 ecu
5½ livers ——½ louisdor (gold)
11 livres ——1 louisdor
22 livres ——1 double louisdor

SPAIN exchanges at 4s. 6d. per piaſter or piece of eight.

372 Marvadies ——1 rial
8 rials ——1 piaſter or piece of eight
gold ½ piſtole ——2 pieces of eight
1 piſtole ——4 pieces of eight
ſilver 1 ducat ——375 mervadies
1 piece of eight——372 mervadies

Italy keeps accounts in livres, ſols and deniers, and exchanges at 4s. 6d. ſterling per piece of eight at par.

6 ſolidi ——1 groſs
24 groſſes ——1 Ducat
12 deniers ——1 ſol
20 ſols ——1 livre
5 livres ——1 piece of eight at Genoa
6 livres ——1 piece of 8 at Leghorn

Rome exchanges with London on the ſcudi, the par of which is 5s. 6d. ſterling.

6 ſolidi ——1 groſs
24 groſs ——1 ducat

Portugal keeps accounts in milreas and reas, and exchanges with London at at 6s. 8½d. ſterling per milrea at par.

A golden ducat ——1 milrea, or 1000 reas
A double piſole ——4000 reas
A ſtamp'd piſo ——48 reas
A current cruſade ——400 reas
A ſtamp'd pacatoon ——600 reas
A ſtamp'd cruſade ——500 reas
A moidore ——27 ſhillings ſterling
A johannes ——36 ditto
A double john ——72 ditto
Half john ——18 ditto
A quarter john ——9 ditto
A teſton ——100 reas

RULE.

As any quantity of foreign money is to its value in ſterling money, ſo is any other quantity of foreign money to its value in ſterling.

Or as any value ſterling to the quantity of foreign money equal thereto, ſo is any other value ſterling to the quantity of the ſame kind of foreign money equal thereto.

Hence all queſtions in Exchange are worked by the Rule of Three, or by Practice, when it is convenient to take parts *.

EXAMPLES.

1—London remits to Dublin 375l. 15s.; what muſt London be credited with there, exchange being at 110 per cent.?

2—Dublin remits to London 276l. 10s.; what muſt be received there, exchange being at 108 per cent.?

3—London remits to Jamaica 327l.; what muſt be received there, exchange being at 145 per cent.?

4—Jamaica remits to London a bill for 1297l. 10s.; what muſt be received there when the exchange is 138 per cent.?

5—How much money muſt be received in Penſylvania for 784l. 16s. paid in London, when the exchange is 125 per cent.?

6—How much ſterling money may be received in Lancaſter for 1279l. 14s. paid in Maryland, exchange at 132 per cent.?

7—How much Flemiſh will 468l. ſterling amount to, exchange at 34s. Flemiſh per pound ſterling?

8—How much ſterling will 749l. 16s. amount to at 34s. Flemiſh per pound ſterling?

9—How many Flemiſh gilders may I have for 347l. 8s. 4d. ſterling, exchange at 35s. 3$\frac{1}{2}$d. per pound ſterling?

10—How

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* EXAMPLE.—In 347l. 10s. Engliſh, how much Iriſh, exchange at 108$\frac{1}{2}$ per cent.?

Becauſe 100l. Engliſh make 108$\frac{1}{2}$l. or 108l. 10s. Iriſh—as 100l. Engliſh to 108l. 10s. Iriſh, ſo is 347l. 10s. Engliſh to 377l. 0s. 9d. Iriſh.

viz. 100l. : 108l. 10s. :: 347l. 10s. : 377l. 0s. 9d.

Or by Practice—

			347	10	
5	0	$\frac{1}{20}$	17	7	6
2	10	$\frac{1}{2}$	8	13	9
1	0	$\frac{1}{5}$	3	9	6
			£377	0	9

5l. is one twentieth of 100l. 2l. 10s. is half of 5l. and 1l. is $\frac{1}{5}$ of 5l. theſe parts of 100l. added to 100l. make 108$\frac{1}{2}$l.

EXAMPLE

10—How much ſterling muſt I receive for 2714 gilders, 15 ſtivers Flemiſh, exchange at 35s. 6d. Flemiſh per pound ſterling?

11—How much ſterling money muſt be received for 275l. 16s. Flemiſh currency, the aigo being 4 per cent. and exchange at 34s. 6d. Flemiſh per pound ſterling?

12—How many Flemiſh marks muſt be received for 396l. ſterling, exchange at 36s. 4d. Flemiſh per pound ſterling?

13—Remitted from London a bill for 1705l. 5s. ſterling; how many gilders muſt be received at Amſterdam, exchange at 34 ſchillings $4\frac{1}{2}$ grotes Flemiſh per pound ſterling?

14—Let 297 gilders 7 ſchillings and 8 pennings, Flemiſh currency, be changed into bank gilders, agio $4\frac{3}{8}$ per cent.?

15—Change 380 gilders, $5\frac{1}{2}$ pennings, bank money, into Flemiſh currency, agio $4\frac{3}{5}$ per cent.?

16—How many French livres muſt be received for 121l. 18s. 6d. ſterling, exchange at $52\frac{7}{8}$d. per ecu?

Example.—In 377l. 0s. 9d. Iriſh, how much Engliſh, at $108\frac{1}{2}$ per cent.?

as 108l. 10s. : 100l. :: 377l. 0s. 9d. : 347l. 10s. If 108l. 10s. Iriſh make 100l. Engliſh, 377l. 0s. 9d. Iriſh will make 347l. 10s. Engliſh.

Example.—In 346l. 15s. Britiſh plantation money, how much Engliſh, exchange at 140 per cent.?

as 140l. : 100l. :: 346l. 15s. : 247l. 13s. $6\frac{3}{4}$d. In this Example it will be eaſy to take parts as in Practice.

Example.—In 346l. Flemiſh, how much ſterling, exchange at 35s. Flemiſh per pound ſterling?

as 35s. : 20s. :: 346l. : 197l. 14s. $3\frac{1}{4}$d. ſterling. It is unneceſſary to reduce the third term, becauſe the firſt and ſecond are in like denominations—the quotient will be the ſame with the third—or you may work by Practice.

Example.—How many Flemiſh guilders muſt be paid for 39l. 15s. 4d. ſterling, exchange at 35s. 6d. Flemiſh per pound ſterling?

as 20s. : 35s. 6d. :: 39l. 15s. 4d. : 423g. : 10ſt.

Reduce the firſt and ſecond terms to pence, and the third to pennings, the quotient will be the pennings, which reduce to guilders.

Example.

17—To how much ſterling will 1982 livres, 10 ſols French, amount to at 51 pence per ecu?

18—How many French crowns may I have for 205l. 7s. 11d. ſterling, exchange at $51\frac{3}{8}$d. per crown?

19—To how much ſterling will 1978 French crowns, 25 ſols amount, exchange at $51\frac{5}{8}$d. per crown?

20—How many crowns muſt be paid at Paris to receive 392l. 8s. at London, exchange at $54\frac{1}{2}$ pence per crown?

21—How much ſterling money muſt be paid in London to receive 1450 crowns 35 ſols, 2 deniers at Paris, exchange at $54\frac{1}{2}$ pence per crown?

22—How many piaſters, &c. ſhall be received in Spain for 255l. ſterling, exchange 50 pence ſterling per piaſter?

23—Spain draws upon London for 1224 piaſters, exchange at 50 pence per piaſter; how much ſterling will it amount to?

24—How many livres, &c. muſt be given at Genoa for 175l. 15s. ſterling, exchange at 52 pence ſterling per piaſter, or piece of eight?

25—Genoa draws upon London for 1500 livres; how much ſterling will ſatisfy this draft, exchange at $50\frac{1}{2}$ pence ſterling per piaſter, or piece of eight?

26—How

Example.—How much ſterling muſt be paid for 423 guilders, 10 ſtivers Flemiſh, exchange at 35s. 6d. Flemiſh per pound ſterling?

as 35s. 6d. : 20s. :: 423g. 10ſt. the firſt and third reduced to pennings will ſtand thus,

as 348p. : 20s. :: 13520p. : 39l. 15s. 4d. anſwer.

Example.—In 160 bank guilders, how many currency, agio $5\frac{5}{8}$ per cent.?

By the agio is meant that 100 bank guilders are equal in value to $105\frac{5}{8}$ current guilders; wherefore the proportion is thus,

as 100 : $105\frac{5}{8}$ :: 160 : 169 currency.

In this manner may any foreign money be changed to ſterling, or ſterling to foreign money, the exchange or proportional value being given, due regard being had to the method of reducing them out of one denomination to another.

We might here proceed to Arbitration of Exchange, but as it is but little practiſed, I omit it to make room for other things.

26—How many ducats at Venice will a draft for 213l. 10s. ſterling amount to, exchange at 49 pence per ducat?

27—Venice draws upon London for 1045 ducats, 22 groſs, exchange at 49d. ſterling per ducat; to how much ſterling does it amount?

28—A merchant at Madrid remits to London 849 pieces of eight at 56 pence per piece; how much ſterling is the ſum?

29—How many Spaniſh pieces of eight at 56 pence per piece, will anſwer a bill for 198l. 2s. ſterling?

30—A gentleman travelling would exchange 121l. 9s. 2d. ſterling for Venice ducats, at 4s. 5d. each; how many muſt he receive?

31—If 550 ducats at 4s. 5d. each be remitted from Venice to London; what is the value in pounds ſterling?

32—A gentleman in Portugal remits to London 2750 milreas, exchange at 6s. 5d. per milrea; how much ſterling will he be credited for in London?

33—If a bill be drawn at London for 881l. 5s. 10d. ſterling; how many milreas at 6s. 5d. each muſt be received in Portugal?

34—How many milreas will 357l. 1s. amount to, exchange at 5s. 8d. per milrea?

35—To how much ſterling will a Portugal draft for 1261 Milreas, 768 reas amount, when the exchange is 5s. 8d. per milrea?

SINGLE FELLOWSHIP.

SINGLE Fellowſhip teaches to proportion the gain or loſs of ſeveral partners or ſharers thereof, according to their ſtocks, without any regard to time.

RULE*.

As the total ſum of the ſtocks to the total gain or loſs, ſo is each man's particular ſtock to his particular gain or loſs.

EXAMPLES.

1—Three men, A, B, and C, make a venture of 120l. of which A paid 30l., B 40l., and C 50l.; they had a return worth 180l.; what is each man's ſhare thereof?

2—Three men, A, B, and C, put in money together, A put in 25l., B 30l., and C. 45l.; they gained 33l. 6s. 8d.; what are their reſpective ſhares of the gain?

3—Three men, A, B, and C, freight a ſhip with wine, A loaded 110 tons, B 97, and C 133; in a ſtorm

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* EXAMPLE.—Three men, A, B, and C, trade together, A advances 8l., B 12l. and C 16l.; they gained 18l.; what is each man's ſhare of the gain?

$$\begin{array}{lr} \text{A's} & 8 \\ \text{B's} & 12 \\ \text{C's} & 16 \\ & \text{—} \\ & 36 \end{array} : 18 :: \left\{\begin{array}{l} 8 : 4 \text{ A's gain.} \\ 12 : 6 \text{ B's gain.} \\ 16 : 8 \text{ C's gain.} \\ \quad\text{—} \\ \quad 18 \text{ Proof.} \end{array}\right.$$

It is evident that becauſe their gains are to be proportioned to their ſtocks, that every man's gain will bear the ſame proportion to his ſtock which the whole gain bears to the whole ſtock; therefore as 36l. the whole ſtock to 18l. the whole gain, ſo is 8l. A's ſtock to 4l. A's gain, and ſo of the reſt.

EXAMPLE.—Divide 152 into three numbers which ſhall be to one another as 3, 7, and 9.

$$\begin{array}{r} 3 \\ 7 \\ 9 \\ \text{—} \\ 19 \end{array} : 152 :: \left\{\begin{array}{l} 3 : 24 \\ 7 : 56 \\ 9 : 72 \end{array}\right\} \text{Numbers ſought.}$$

for $3 : 7 :: 24 : 56$, and ſo of the reſt.

By this a bankrupt's eſtate is divided among the creditors; alſo lands are divided among the proprietors, &c.

If the ſecond term be divided by the firſt, the quotient will be a common multiplier, by which you may multiply each third term for the anſwer—but this is moſt convenient in decimals.

ſtorm 85 tons were thrown overboard; how much muſt each ſuſtain of the loſs?

4—46 acres, 3 roods and 35 perches of land is to be divided among 4 men, A, B, C, and D, in proportion to their eſtates; now A's eſtate is valued at 80l., B's 120l., C's 200l., and D's at 300l. per annum; what quantity of land muſt each have?

5—Two men, A and B company, A put in 20l., B put in 144 ducats; they gained 67l. 10s., of which A's ſhare was 30l.; what was the value of a ducat?

6—A bankrupt owes to 6 perſons, A, B, C, D, E, and F, the following ſums, viz. to A 140l., to B 180l., to C 320l. 10s., to D 280l., to E 674l. 10s., and to F 1000l., and his eſtate is found to be worth only 1946l. 5s.; what muſt each creditor receive, and what does he pay in the pound?

DOUBLE FELLOWSHIP.

DOUBLE Fellowſhip, or Fellowſhip with Time, is when the gain or loſs is proportioned to both ſtock and the time it is employed.

RULE[*].

Multiply each man's money or ſtock by the time of its continuance in company, then ſay, as the total ſum of

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[*] EXAMPLE.—Three men, A, B, and C, trade together, A had 30l. in company 12 months, B had 50l. in company 9 months, and C had 80l. in company 6 months, they gained 32l. 5s.; what is each man's ſhare of the gain?

A 30×12=360
B 50× 9=450
C 80× 6=480

	£.	s.			£.	s.	
1290 :	32	5 ::	360 :		9		A's ſhare
			450 :		11	5	B's ſhare
			480 :		12		C's ſhare
					32	5	Proof.

And

of thoſe products is to the total gain or loſs, ſo is each particular product to each man's ſhare of the gain or loſs.

EXAMPLES.

1—A and B trade together, A had 60l. in the buſineſs 12 months, and B 70l. 9 months; they gained 54l.; what is each man's ſhare thereof?

2—Three men, A, B, and C, trade together, A put in 85l., B 110l., and C 145l., but A's money was in company 12 months, B's 9 months, and C's 6 months; they gained 96l.; what is each man's ſhare of the gain?

3—A began buſineſs with a ſtock of 240l., which not being ſufficient to anſwer his intended purpoſe, he took B and C into partnerſhip at four months' end, A with a ſtock of 360l., and B with one of 480l.: at the expiration of the year, upon ſettling accounts, they found there was a gain of 108l.; what is each man's ſhare?

4—Four perſons join in company for 12 months, each with a ſtock of 300l., but at the end of 2 months B took out 120l., A putting in 150l. at the ſame time,

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And in this manner may any ſum be divided in proportion both to money and time: but the whole amount muſt not be ſo proportioned; for,

EXAMPLE.—If A and B trade together, A with a ſtock of 20l. which was in company 12 months, and B with a ſtock of 200l. which was in company but 1 month; the amount of their ſtock and gain was then 264l.: what is each man's ſhare thereof.

A 20×12=240
B 200× 1=200

$$440 : 264 :: \begin{cases} 240 : 144 = \text{A's ſhare.} \\ 200 : 120 = \text{B's ſhare.} \end{cases}$$

264

By this method A gains 124l. and B loſes 80l. which ought not to be the caſe: but dividing the gain only A muſt receive 24l. and B 20l. thereof; conſequently A's ſhare of the whole will be 44l. and B's 220l. Hence it is neceſſary to take care that the principal be not divided in the ſame manner as the gain.

time, but at the end of 5 months he took out 200l., and B put in the ſame ſum; at 6 months' end, B afterwards put in 50l. more at the end of 9 months, A putting in at the ſame time 150l.; C put in 180l. at the end of 4 months to what he at firſt had in, but took out 220l. at 9 months' end, putting in 60 at the end of 10 months: D advanced 100l. to the ſtock at 7 months' end and 50l. at 9 months' end; now they gained 333l.; how muſt the ſame be divided among them?

5—Four perſons, A, B, C, and D, take a quantity of ground for which they are to pay 103l. 6s.; A grazed 24 oxen for 21 weeks, B grazed 32 oxen 16 weeks, C 18 oxen 25 weeks, and D 40 oxen 15 weeks; what muſt each pay of the ſaid rent, and how much is that for each ox per week?

VULGAR

VULGAR FRACTIONS.

A Fraction is a part of any thing.

A Vulgar Fraction is expreſſed by two numbers one written above the other, with a ſmall line drawn betwixt, as $\frac{8}{9}$; the lower number is called the denominator, which ſhews into how many parts unity or any thing is divided; and the higher the numerator, which ſhews how many ſuch parts are ſignified by the fraction.

So if any thing be divided into 8 equal parts, then 7 of thoſe parts will be expreſſed thus, $\frac{7}{8}$, ſeven eighths; where 7 is the numerator, and 8 the denominator.

Alſo, the numerator divided by the denominator is what is meant by a vulgar fraction; ſo 7 divided by 8 is the value of $\frac{7}{8}$.

A proper fraction has its numerator leſs than its denominator, and the fraction is leſs than unity, as $\frac{3}{4}$.

An improper fraction has its numerator greater than its denominator, and the fraction is more than unity, as $\frac{7}{4}$.

A compound fraction is a fraction of a fraction, being expreſſed by two fractions with the word *of* between them, as $\frac{3}{4}$ of $\frac{4}{5}$, $\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{8}{9}$, &c.

A mixt number is compoſed of a whole number and a fraction annexed to it, which is added thereto, as $5\frac{3}{4}$, that is 5 and $\frac{3}{4}$.

REDUCTION.

By reduction we change fractions out of one denomination into another, or to a given denominator; alſo ſeveral fractions to a common denominator, ſingle fractions to their loweſt terms, compound fractions to ſingle ones, mixt numbers to improper fractions, and improper fractions to mixt numbers, &c.

I. *

To find the greateſt common meaſure of a vulgar fraction.

RULE.

Divide the denominator by the numerator and the diviſor by the remainder continually till nothing remain; the laſt diviſor is the greateſt common meaſure ſought.

EXAMPLES.

1—What is the greateſt common meaſure of $\frac{21}{24}$?
2—What is the greateſt common meaſure of $\frac{108}{117}$?
3—What is the greateſt common meaſure of $\frac{1584}{1728}$?
4—What is the greateſt common meaſure of $\frac{7268}{14368}$?
5—What is the greateſt common meaſure of $\frac{420}{938}$?
6—What is the greateſt common meaſure of $\frac{10557}{11691}$?
7—What

I. *

EXAMPLE.—What is the greateſt common meaſure of $\frac{49}{168}$?

```
              49)168(3
                 147
                 ———
                  21)49(2
                     42
7)49/168(7/24        ——
                      7)21(3
                        21
                        —
                        0
```

This is no more than to find the greateſt number which will divide two given numbers without a remainder; therefore divide the greater number by the leſs, and that diviſor by the remainder, and that diviſor by the remainder again, till nothing remains; the laſt diviſor 7 is the greateſt common meaſure ſought.

For if 7 will divide 21, it will divide twice 21 and 7 which is 49, and becauſe it will divide 49 it will divide 3 times 49 and 21 which is 168 without any remainder. Hence a number will divide any multiple thereof added to itſelf, or any multiple of a multiple added to a multiple and to itſelf, and ſo on without a remainder, from whence comes the rule.

7—What is the greateſt common meaſure of $\frac{15325}{33715}$?
8—What is the greateſt common meaſure of $\frac{153007}{16911}$?

II. †

To reduce a vulgar fraction to its loweſt terms.

RULE.

Divide both numerator and denominator by any one number which will divide both without a remainder; the quotients will be the numerator and denominator of a Fraction expreſſing the ſame value, and which you may reduce again in the ſame manner, and ſo on till you can find no number which will divide both without a remainder, then you may ſuppoſe the fraction is in its loweſt terms. Or, firſt find the greateſt common meaſure, and divide both numerator and denominator thereby; the quotients will be the numerator and denominator of the ſame fraction in its loweſt terms.

EXAMPLES.

1—Reduce $\frac{63}{84}$ to its loweſt terms.
2—Reduce $\frac{420}{938}$ to its loweſt terms.

II. †

To reduce a vulgar fraction to its loweſt terms is to expreſs the ſame value by ſmaller numbers; ſo if you were to divide any thing into 16 equal parts, 12 ſuch parts, viz. $\frac{12}{16}$ would only be the ſame as if you had divided the ſame thing into 4 equal parts, and taken 3 of thoſe parts, viz. $\frac{3}{4}$: wherefore $\frac{12}{16}=\frac{3}{4}$: ſo that while the numerator bears the ſame proportion to the denominator, the fraction has the ſame value.

as 9 : 12 :: 6 : 8 Wherefore $\frac{9}{12}=\frac{6}{8}$, and if both diviſor and dividend be multiplied, or divided by one and the ſame number they will ſtill give the ſame quotient.

```
 8)56(7      ſo 56 divided by 8, or 3 times 56 divided by 3
 3) 3        times 8 gives 7.
————
24)168(7
```

3—Reduce $\frac{11536}{11691}$, $\frac{7268}{14368}$, $\frac{1584}{1728}$, $\frac{364}{728}$, and $\frac{4678}{5216}$ reſpectively to their loweſt terms.

4--Reduce $\frac{2\times7\times8\times3}{3\times8\times9\times6}$ to its loweſt terms.

5—Reduce $\frac{153007}{169113}$ to its loweſt terms.

III. ‡

To reduce a fraction to a given denominator.

RULE.

As the denominator of the given fraction to its numerator, ſo is the denominator of the required fraction to its numerator.

EXAMPLE.—Reduce $\frac{36}{48}$ to its loweſt terms.

$\frac{36}{48}=\frac{12}{16}=\frac{3}{4}$, or, $\frac{36}{48}=\frac{3}{4}$ 36 and 48 both divided by 3, give 12 and 16, theſe both divided by 4 give 3 and 4 or $\frac{3}{4}$, which cannot be divided again.

Or, find the greateſt common meaſure of $\frac{36}{48}$, which is 12, divide both thereby, and there reſults $\frac{3}{4}$ as before.

If the numerator or denominator conſiſt of ſeveral numbers connected by addition or ſubtraction, it is beſt to add or ſubtract them ſo as to bring them into one number; as,

$\frac{3+7+5-6}{10-3+4}=\frac{9}{11}$ for ſuch fractions cannot be divided but by a number which will divide each one; but if they conſiſt of numbers multiplied together, you may cancel or omit ſuch numbers as are found in both numerator and denominator, or divide any one number in each by ſuch a number as will divide both.

ſo in $\frac{3\times4\times7\times5}{4\times7\times9\times8}$ where 4 and 7 may be cancelled in both numerator and denominator. and 3 and 9 in each may be divided by 3, by which the expreſſion is depreſſed to $\frac{1\times5}{3\times8}=\frac{5}{24}$ If all the numbers were multiplied together, the products would be a fraction reducible to $\frac{6}{24}$ as before.

III. ‡

EXAMPLE.—Reduce $\frac{3}{4}$ to a fraction with 12 for its denominator. as 4 : 3 :: 12 : 9 the numerator, wherefore $\frac{3}{4}=\frac{9}{12}$, for it is evident, that when the numerators bear the ſame proportion to their denominators reſpectively, the fractions muſt be equal.

EXAMPLES.

1—Reduce $\frac{12}{15}$ to a fraction with 105 for its denominator.
2—Reduce $\frac{12}{16}$ to a fraction with 186 for its denominator.
3—Reduce $\frac{7}{9}$ to a fraction with 117 for its denominator.
4—Reduce $\frac{28}{32}$ to a fraction with 24 for its denominator.
5—Reduce $\frac{3}{4}$ to a fractson with 112 for its denominator.

IV. ||

To reduce a whole or mixt number to an improper fraction.

RULE.

If it is a whole number without any aſſigned denominator, write it for a numerator, and 1 for the denominator: but if it is to have an aſſigned denominator, multiply the given whole number by the aſſigned denominator for a numerator, under which write the aſſigned denominator. For a mixt number, multiply the whole number by the denominator of the fraction, to the product add the numerator; the ſum will be the numerator of the improper fraction required, udder which write the denominator of the given fraction.

EXAMPLES.

1—Write 17 as a fraction.
2—Reduce 17 to a fraction with 7 for its denominator.

3—Reduce

Fractions may often be reduced to a given denominator by multiplying or dividing both parts by ſuch a number as as will make the given fraction have the required denominator; ſo $\frac{3}{4}\times\frac{3}{3}=\frac{9}{12}$ as before.

IV. ||

EXAMPLE.—Reduce $7\frac{3}{4}$ to an improper fraction.

$\frac{7\times4+3}{4}=\frac{31}{4}$ 7 multiplied by 4, and 3 added to the product make 31 for the numerator, 4 the denominator of the fraction ſtill applied, makes $\frac{31}{4}$ the improper fraction required; for, if 7 be reduced to quarters, and 3 quarters dded thereto, it makes 31 quarters, or $\frac{31}{4}$.

3—Reduce 45 to a fraction with 84 for its denominator.
4—Reduce $1\frac{3}{4}$ to an improper fraction.
5—Reduce $17\frac{4}{5}$ to an improper fraction.
6—Reduce 4, $7\frac{3}{4}$, $18\frac{5}{9}$, $174\frac{13}{16}$, and $24\frac{28}{32}$ reſpectively to improper fractions.

V. §

To reduce improper fractions to whole or mixt numbers.

RULE.

Divide the numerator by the denominator, the quotient will be a whole number, the remainder will be the numerator, and the diviſor the denominator of the fraction.

EXAMPLES.

1—Reduce $\frac{17}{4}$ to a mixt number.
2—Reduce $\frac{246}{18}$ to a mixt number.
3—Reduce $\frac{7468}{125}$ to a mixt number.
4—Reduce $\frac{284}{27}$, $\frac{96}{12}$, $\frac{3748}{124}$, $\frac{912}{12}$, $\frac{37568}{237}$, and $\frac{37269}{489}$ to whole and mixt numbers.

VI. ¶

To reduce compound fractions to ſingle ones.

V. §

EXAMPLE.—Reduce $\frac{246}{18}$ to a mixt number.

$18)246(13\frac{12}{18}$ This is no more than to divide the numerator by the denominator; for $\frac{246}{18}$ ſignifies 246 divided by 18, which gives $13\frac{12}{18}$ for the quotient.

VI. ¶

EXAMPLE.—Reduce $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{7}{8}$ to a ſimple or ſingle fraction.

$\frac{1}{2}\times\frac{3}{4}\times\frac{7}{8}=\frac{21}{64}$ The numerators 1, 3, 7, multiplied together make 21 for the numerator, and 2, 4, and 8 multiplied together produce 64 for the denominator; ſo that $\frac{21}{64}$ is the ſimple fraction required.

$\frac{1}{2}$ of $\frac{3}{4}$ is the ſame as $\frac{1}{2}$ a time $\frac{3}{4}$; hence a compound fraction denotes the produce of thoſe fractions.

RULE.

Multiply the numerators together for the numerator, and the denominators together for the denominator of the ſingle or ſimple fractions required.

EXAMPLES.

1—Reduce $\frac{7}{9}$ of $\frac{4}{5}$ of $\frac{5}{8}$ to a ſimple fraction.
2—Reduce $\frac{2}{3}$ of $\frac{3}{4}$ to a ſingle fraction, and to its loweſt terms.
3—Reduce $\frac{3}{4}$ of $\frac{7}{8}$ of $2\frac{1}{3}$ to a ſingle fraction.
4—Reduce $\frac{7}{8}$ of $\frac{8}{10}$ of $8\frac{8}{12}$ to a ſingle fraction, and to its loweſt terms.

VII. *

To reduce fractions to other denominations.

RULE.

When they are to be reduced to a leſs denomination, multiply the numerator by ſuch numbers as you would multiply by in common Reduction: but when they are to be reduced to a greater denomination, multiply the denominator by ſuch numbers as you would divide by in common Reduction.

EXAMPLES.

1—Reduce $\frac{2}{30}$l. to the fraction of a ſhilling.
2—Reduce $\frac{7}{8}$ of a ſhilling to the fraction of a pound.
3—Reduce $\frac{5}{9}$ of a pound to the fraction of a hundred weight.

4—Reduce

VII. *

EXAMPLE.—Reduce 2s. 4d. to the fraction of a pound.

1l.=240d., and 2s. 4d.=28d. Wherefore 2s. 4d.=$\frac{28}{240}$l. Becauſe 1 penny is the 240th part of a pound, 28 pence is $\frac{28}{240}$ of a pound.

The integer to any fraction is that which the fraction is ſuppoſed to be part of: ſo, when 2s. 4d. is to be the fraction of a pound 1l. is the integer.

4—Reduce $\frac{5}{7}$ of a yard to the fraction of an ell engliſh.
5—Reduce $\frac{17}{29}$ of a noble to the fraction of a crown.
6—Reduce $\frac{3}{468}$ of a year to the fraction of a week

VIII. †

To reduce the parts of coin, weight, meaſure, &c. into Vulgar Fractions.

RULE.

Let the given parts be expreſſed in a ſimple quantity, by reducing them to the loweſt name mentioned, for a numerator; and reduce the integer to the ſame denomination for a denominator.

EXAMPLES.

1—Reduce 3s. 4d. to the fraction of a pound ſterling.
2—Reduce 7 pence to the fraction of a pound.
3—Reduce 3 qr. 7 lb. to the fraction of a hundred weight.
4—Reduce 18s. $7\frac{1}{4}$d. to the fraction of a pound.
5—Reduce 4s. $6\frac{3}{4}$ to the fraction of a guinea.
6—Reduce 3 quarters, 3 nails to the fraction of a yard.
7—Reduce 34 gallons, 2 quarts and 1 pint to the fraction of a hogſhead.
8—Reduce 7 months, 2 weeks and 3 days to the fraction of a year.

VIII. †

EXAMPLE.—What is the value of $\frac{3}{5}$ of a hundred weight?

3 *qr.* *lb.*
4
5)12(2 $11\frac{1}{5}$
10
—
2
28
—
5)56($11\frac{1}{5}$

This is no more than to divide 3 cwt. by 5, as in compound diviſion; for $\frac{3}{5}$ is 3 divided by 5: and whatever name the fraction bears it is ſo many of that name as is expreſſed by the numerator and divided by the denominator.

IX. ‡

To find the value of a Vulgar Fraction.

RULE.

Divide the numerator by the denominator, reducing it as in compound diviſion.

EXAMPLES.

1—What is the value of $\frac{7}{8}$l. ?
2—What is the value of $\frac{17}{21}$ of a guinea ?
3—What is the value of $\frac{247}{960}$ of a pound ſterling ?
4—What is the value of $\frac{13}{28}$ of a hundred weight ?
5—What is the value of $\frac{27}{156}$ of a ton ?
6—What is the value of $\frac{4}{34}$ of a mile ?
7—What is the value of $\frac{27}{134}$ of a year ?

X. ‖

To reduce ſeveral fractions to one common denominator.

Multiply

IX. ‡

To reduce fractions to a common denominator is to change them into others which ſhall have all one and the ſame denominator, and ſtill retain the ſame value.

Example.—Reduce $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$ to a common denominator.

$$\left.\begin{array}{l}2\times4\times5=40\\3\times3\times5=45\\4\times3\times4=48\end{array}\right\}\text{Numerators.}$$

$$3\times4\times5=60\quad\text{Denominator}$$

$\frac{2}{3}=\frac{40}{60}$, $\frac{3}{4}=\frac{45}{60}$, $\frac{4}{5}=\frac{48}{60}$, $\frac{40}{60}$, $\frac{45}{60}$, and $\frac{48}{60}$ have all the ſame denominator.

Here each numerator is multiplied by all the denominators but its own for a numerator; its denominator is multiplied by the ſame numbers, conſequently the fraction retains its former value.

X. ‖

Fractions may frequently be reduced to a common denominator by conſidering what number to multiply the numerator and denominator by, ſo as to produce a denominator which may be divided by each denominator; ſo, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{7}{12}$.

$$\begin{array}{r}\frac{7}{12}\\\frac{3}{4}=\frac{9}{12}\\\frac{2}{3}=\frac{8}{12}\end{array}$$

If

RULE.

Multiply each numerator by all the dtnominators except its own for new numerators, and all the denominators one into another for the common denominator.

EXAMPLES.

1—Reduce $\frac{2}{3}$, $\frac{3}{4}$ and $\frac{4}{5}$ to a common denominator.
2—Reduce $\frac{7}{8}$, $\frac{4}{5}$, $\frac{6}{9}$ and $\frac{7}{12}$ to a common denominator.
3—Reduce $4\frac{1}{7}$, $\frac{5}{16}$, $\frac{8}{9}$ and $\frac{3}{8}$ to a common denominator.
4—Reduce $1\frac{1}{2}$, and $\frac{2}{3}$ till they have both the ſame denominator.
5—Reduce $\frac{2}{3}$, $\frac{5}{9}$ and $\frac{13}{18}$ to a common denominator.
6—Reduce $4\frac{4}{6}$, $\frac{2}{3}$ of $\frac{3}{4}$, and $\frac{5}{8}$ to a common denominator.
7—Reduce $\frac{2}{3}$ of 3, $\frac{7}{8}$ of $1\frac{1}{2}$ and $3\frac{1}{9}$ to a common denominator.
8—Reduce $\frac{4}{28}$, $\frac{17}{56}$ and $\frac{124}{224}$ to a common denominator.
9—Reduce $\frac{2}{3}$ of a ſhilling and $\frac{2}{48}$ of a pound to a common denominator.

QUESTIONS
IN
REDUCTION.

1—Reduce $2\frac{1}{2}$ and $4\frac{1}{3}$ to a common denominator.
2—Reduce $4\frac{3}{6}$ to an improper fraction with 84 for its denominator.
3—Reduce $2\frac{1}{2}$ and $\frac{3}{4}$ of $\frac{5}{6}$ to a common denominator.
4—What is the value of $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of a foot?
5—What is the value of $\frac{7}{8}$ of a ſhilling?

6—Reduce

If any of the fractions are to be reduced to a common denominator, it will be beſt to reduce ſuch to their loweſt terms before you reduce them to a common denominator.

6—Reduce $7\frac{4}{5}$ to an improper fraction.
7—Reduce $\frac{39}{5}$ to a mixt number.
8—Reduce $\frac{12}{16}$ of $\frac{6}{8}$ to a ſingle fraction, and to its loweſt terms.
9—Reduce $\frac{5}{6}$ of a mile to its proper terms.
10—Reduce $\frac{7}{8}$ of an inch to the fraction of a foot.
11—Reduce $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of 3 yards to the fraction of a foot, and to its loweſt terms.
12—Reduce $\frac{7}{8}$ of a ſhilling and $\frac{7}{24}$ of a pound to one denomination and a common denominator.
13—Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of a ſhilling to the fraction of a pound with 320 for its denominator.
14—What is the value of $\frac{7}{9}$ of a moidore?
15—What is the worth of $\frac{3}{8}$ of a ſhip, value 1730l.?
16—What will $\frac{1}{2}$ of $\frac{1}{3}$ of 100l- amount to?
17—Reduce $\frac{7}{8}$ of a pole to the fraction of a league.
18—Reduce $\frac{2}{22400}$ of a ton to the fraction of a pound.

ADDITION

OF

VULGAR FRACTIONS.

REDUCE compound fractions to ſingle ones, fractions of different denominations to one and the ſame denomination, and all the fractions to a common denominator.

Add all the numerators together for the numerator of the ſum, under which write the common denominator. *

EXAMPLES.

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* EXAMPLE.—Add $\frac{5}{12}$, and $\frac{3}{12}$ together.

$$\frac{5+3}{12}=\frac{8}{12}=\frac{2}{3}$$

When all the fractions have the ſame denominator, (called a common denominator) the numerators may be added, and the common denominator written for the denominator, as in the example: for 1 penny being $\frac{1}{12}$ of a ſhilling, 5 pence is $\frac{5}{12}$ of a ſhilling, and 3 pence

EXAMPLES.

1—Add $\frac{7}{9}$ and $\frac{3}{9}$ together.
2—Add $\frac{4}{16}$, $\frac{7}{16}$, $\frac{5}{16}$ and $\frac{9}{16}$ together.
3—Add $\frac{5}{28}$, $\frac{11}{28}$, $\frac{13}{28}$, $\frac{17}{28}$ and $\frac{20}{28}$ together.
4—Add $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$ and $\frac{5}{6}$ together.
5—Add $\frac{2}{7}$, $\frac{3}{5}$ of $\frac{5}{8}$ and $\frac{11}{12}$ together.
6—Add $\frac{7}{16}$, $3\frac{7}{9}$, $5\frac{8}{10}$, and $\frac{2}{3}$ of $7\frac{1}{2}$ together.
7—Add $3\frac{7}{9}$l., $15\frac{5}{8}$l., and 7l. 12s. 9d. together.
8—Add $\frac{7}{9}$ of a ſhilling to $\frac{1}{24}$ of a pound.
9—To $\frac{5}{6}$ of a crown add $\frac{7}{8}$ of a noble.
10—To $\frac{4}{16}$ of a foot add $\frac{1}{9}$ of a yard and $7\frac{2}{3}$ inches.
11—To $\frac{7}{8}$ of a mark add $\frac{5}{9}$ of a moidore.
12—To $\frac{3}{5}$ of a yard add $\frac{1}{2}$ of a foot and $\frac{1}{6}$ of a pole.

SUBTRACTION

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3 pence is $\frac{3}{12}$ of a ſhilling; now 5d. and 3d. is 8d. or $\frac{8}{12}$ of a ſhilling, which reduced to the loweſt terms make $\frac{2}{3}$ds.

That fractions cannot be added till they have a common denominator is evident by conſidering how 9 pence muſt be added to 3 ſhillings: for 9+3=12 neither pence nor ſhillings; ſo 9 pence is $\frac{9}{240}$ of a pound, and 3 ſhillings is $\frac{3}{20}$ of a pound; now $\frac{9}{240}$, and $\frac{3}{20}$ will not make $\frac{12}{240}$, or $\frac{12}{20}$, but 3s. is 36 pence or $\frac{35}{240}$, and 36 pence and 9 pence make 45 pence, or $\frac{36}{240}$ and $\frac{9}{240}$ make $\frac{45}{240}$.

EXAMPLE.—Add $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{4}{5}$ together.

$$\left.\begin{array}{l} 2\times4\times5=40 \\ 3\times3\times5=45 \\ 4\times3\times4=48 \end{array}\right\}\text{Numerators.}$$

$$\frac{133}{60}=2\tfrac{1}{20}$$

$3\times4\times5$

Reduced to a common denominator, the ſum of the numerators is 123, and the common denominator 60: wherefore the ſum is $\frac{123}{60}$ reduced to the loweſt terms, and to a mixt number make $2\frac{1}{20}$.

Add $\frac{2}{3}$ of a ſhilling to $\frac{3}{4}$ of a pound.

$\frac{2}{3}$s.$=\frac{2}{60}$l.   or $\frac{3}{4}$l.$=\frac{60}{4}$s.$=\frac{180}{12}$
$\frac{3}{4}$l.$=\frac{45}{60}$l. $\frac{3}{4}$s. $=$ $\frac{9}{12}$

$\frac{46}{60}$l. = 15s. 9d.

The Fraction of a pound may be reduced to the fraction of a ſhilling, or the fraction of a ſhilling to the fraction of a pound; or their values may be found and then added—All thoſe methods give the ſame ſum as in the work; but fractions cannot be added till they be all of one denomination, as well as having a common denominator.

SUBTRACTION
OF
VULGAR FRACTIONS.

PREPARE your fractions as directed in addition: take the difference of the numerators for a numerator, under which write the common denominator, and you will have a fraction expreſſing the difference of the two fractions*.

EXAMPLES.

1—From $\frac{7}{9}$ take $\frac{3}{9}$.
2—From $\frac{4}{5}$ take $\frac{4}{9}$.
3—From $6\frac{1}{9}$ take $5\frac{2}{3}$.
4—From 2l. 13s. 6d. take $1\frac{5}{8}$l.
5—From $\frac{247}{346}$ take $\frac{120}{346}$.
6—From $\frac{7}{8}$ take $\frac{5}{6}$ of $\frac{8}{9}$.
7—What is the difference between $\frac{5}{9}$ of a guinea and $\frac{7}{8}$ of a pound?
8—What is the difference between 7l. 14s. 11d. and $15\frac{3}{6}$l.?
9—What is the difference between 6 cwt. 1 qr. 7lb. and $4\frac{27}{42}$ cwt.?
10—From $\frac{3}{8}$ of a yard take $\frac{2}{3}$ of a foot.

MULTIPLICATION
OF
VULGAR FRACTIONS.

REDUCE mixt numbers to improper fractions, multiply the numerators together for the numerator, and the denominators together for the denominator of the product.

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* In this the fractions muſt be reduced to a common denominator, and to the ſame denomination as in addition, and for the ſame reaſons, which need not be repeated here.

EXAMPLES.

1—Multiply $\frac{7}{9}$ by $\frac{3}{4}$.
2—Multiply $4\frac{5}{8}$ by $\frac{2}{3}$.
3—Multiply $17\frac{4}{5}$ by $6\frac{3}{4}$.
4—Multiply 7l. 14s. 6d. by $2\frac{5}{6}$.
5—Multiply $\frac{127}{346}$ by $\frac{72}{684}$.
6—Multiply 3 feet 9 inches by $7\frac{1}{2}$.
7—Multiply 17 feet 9 inches by 8 feet 6 inches.
8—Multiply $17\frac{6}{9}$ by $14\frac{5}{8}$.
9—Multiply $\frac{3}{4}$ by $\frac{4}{3}$.
10—Multiply $\frac{74}{186}$ by $2\frac{38}{74}$.

DIVISION
OF
VULGAR FRACTIONS.

MULTIPLY the dividend by the reciprocal of the divisor, and the product will be the quotient.

The

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* EXAMPLE.—Multiply $\frac{7}{8}$ by $\frac{3}{4}$.

$$\frac{7\times3}{8\times4}=\frac{21}{32}$$

The numerators multiplied together, and the denominators together, as in the rule, give $\frac{21}{32}$ for the product.

Mixt numbers muſt be reduced to improper fractions, and whole numbers written fractionwiſe, ſo $2\frac{3}{4}$, $\times 3$ is $\frac{11}{4}\times\frac{3}{1}$ which make $\frac{33}{4}$. The product may be reduced to its loweſt terms, and if it is an improper fraction it may be reduced to a mixt number, as $\frac{3}{4}=8\frac{1}{4}$.

Multiply $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{6}{8}$ together.

$$\frac{3\times\cancel{4}\times\cancel{5}\times\cancel{6}}{\cancel{4}\times\cancel{5}\times\cancel{6}\times8}=\frac{3}{8}$$

If you find a number in the numerator and one in the denominator alike, they may both be cancelled; or when they can both be divided by one number, ſubſtitute their quotients in their places, by which the work may be contracted.

To multiply by a fraction is to multiply by the numerator and divide by the denominator; but to divide a fraction, multiply the denominator; therefore to multiply a fraction by a fraction, multiply the numerator by the numerator and the denominator by the denominator.

To multiply by a fraction leſs than unity diminiſhes the multiplicand, for $1\times\frac{3}{4}$ is $\frac{3}{4}$ of 1, and $12\times\frac{3}{4}=\frac{3}{4}$ of $12=9$.

The reciprocal of a fraction is the numerator put for the denominator, and the denominator for the numerator *.

EXAMPLES.

1—Divide $\frac{7}{8}$ by $\frac{2}{3}$.
2—Divide $\frac{74}{128}$ by $\frac{128}{74}$.
3—Divide $\frac{3}{4}$ by $\frac{4}{3}$.
4—Divide $128\frac{3}{4}$ by $3\frac{5}{9}$.
5—Divide 1 by $2\frac{38}{74}$.
6—Divide 1 by $\frac{4}{3}$.
7—Divide 150 feet $10\frac{1}{2}$ inches by 17 feet 9 inches.
8—Divide 21l. 17s. 9d. by 7l. 14s. 6d.
9—Divide 21l. 17s. 9d. by $2\frac{5}{6}$.
10—Divide $\frac{1}{2}$ of $\frac{3}{4}$ by $\frac{2}{3}$ of $\frac{1}{8}$.

RULE OF THREE IN VULGAR FRACTIONS.

STATE the queſtion by the directions in the common Rule of Three; multiply and divide, &c. by the rules in Vulgar Fractions. For this and the following rules in

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* To divide a vulgar fraction is the ſame as to multiply the denominator; for to multiply the diviſor and divide the quotient is the ſame: ſo 72 divided by 4 and that quotient by 3 is the ſame as to divide by 3 times 4 or 12. And to multiply a vulgar fraction is to multiply the numerator, for if the quotient be multiplied it is the ſame as to multiply the dividend; for if 24 be divided by 6, and the quotient multiplied by 3, it will produce 12, ſo if 24 be multiplied by 3 and the product divided by 6, the quotient will be 12.

Hence, if $\frac{3}{4}$ be divided by $\frac{5}{6}$, multiply 3 by 6 which gives 18 for the numerator, and 4 by 5 gives 20 for the denominator, and the quotient is $\frac{18}{20}$ or $\frac{9}{10}$; that is, multiply the numerator of the dividend by the denominator of the diviſor for the numerator of the quotient, and the denominator of the dividend by the numerator of the diviſor for the denominator of the quotient;—which is the ſame as to invert the diviſor, changing the numerator into the denominator and the denominator into a numerator, making the reciprocal of the fraction, and work as in multiplication; ſo,

$$\frac{3}{4} \div \frac{5}{6} = \frac{3}{4} \times \frac{6}{5} = \frac{18}{20} = \frac{9}{10}.$$

in vulgar fractions differ from the ſame rules in common numbers, only as the foregoing rules in fractions differ from the ſame rules in whole numbers *.

EXAMPLES.

1—If $\frac{3}{4}$ of a ſhilling buy $\frac{7}{9}$ of a lb. how many ounces may I have for a crown?

2—If $7\frac{7}{8}$ yards of cloth coſt 1l. 9s. 4d. what will $36\frac{9}{16}$ yards coſt?

3—What length of $\frac{3}{4}$ of an inch broad ſtuff will cover a ſquare foot?

4—If I buy $174\frac{2}{3}$ yards of cloth for 43l. 13s. 4d. how muſt I ſell it per ell Engliſh to gain 4l. 7s. 4d. by the whole?

5—If a man travel $3\frac{2}{3}$ miles every hour; how many miles will he travel in $7\frac{3}{4}$ hours?

6—If 100l. gain 3l. 15s. intereſt in $\frac{3}{4}$ of a year, in what time will 33l. 6s. 8d. gain the ſame intereſt?

7—If 100l. gain $3\frac{3}{4}$l. in $\frac{3}{4}$ of a year, what will the ſame money gain in $4\frac{1}{3}$ years?

8—If 6 men do a piece of work in $10\frac{3}{4}$ hours, in what time will 15 men do the ſame?

9—If 100l. gain 1l. 5s. in $\frac{1}{4}$ of a year, what will 433l. 6s. 8d. gain in $7\frac{3}{4}$ years?

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* EXAMPLE.—If $\frac{2}{3}$ of a yard coſt $\frac{1}{6}$l., what will $17\frac{3}{4}$ yards coſt?

$$\begin{array}{lllllll} y. & l. & y. & & & & \\ \frac{2}{3} : & \frac{1}{6} :: & 17\frac{3}{4} & & & & \\ \frac{2}{3} : & \frac{1}{6} :: & \frac{71}{4} & l. & l. & s. & d. \\ \frac{3}{2}\times & \frac{1}{6} \times & \frac{71}{4} = & \frac{71}{16} = & 4 & 8 & 9 \end{array}$$

State the queſtion by the directions given in the common Rule of Three; for that number or fraction which requires the anſwer muſt be the laſt term in the ſtating, the firſt muſt be of the ſame kind with the third, and the middle number of the ſame kind with the anſwer.

If the firſt and third be of different denominations you may reduce the firſt to the ſame name with the third, or the third to the ſame name with the firſt. Mixt numbers muſt be reduced to improper fractions, and compound numbers to vulgar fractions.

Multiply the reciprocal of the diviſor by the other terms, and the product will be the anſwer, which may be reduced to a mixt number, or its value found as the caſe may require.

10—If $14\frac{3}{4}$ cwt. be carried $7\frac{1}{2}$ miles for $\frac{7}{8}$l. how far may 34 cwt. 3 qr. 14 lb. be carried for 7l. 13s. 4d.?

11—If $\frac{2}{3}$ of $\frac{5}{8}$ of 16 buſhels of wheat be ſufficient for a family of 6 perſons $6\frac{1}{2}$ weeks, how much will be ſufficient for a family of 21 perſons a whole year?

12—If $\frac{3}{4}$ of a lottery ticket coſt 12l. 15s. how muſt a prize of 1000l. for the whole ticket be divided among 4 men who joined for the $\frac{3}{4}$?

PROMISCUOUS QUESTIONS.

1—What number added to $\frac{14}{27}$ will make $1\frac{3}{5}$?

2—What number ſubtracted from $1\frac{7}{8}$ will leave $\frac{7}{29}$?

3—What number multiplied by $\frac{3}{4}$ will produce $\frac{5}{6}$?

4—What number divided by $\frac{5}{6}$ will give $\frac{5}{8}$?

5—What is the ſum, difference, product, and quotient of $\frac{17}{29}$ and $\frac{16}{34}$?

6—If I buy cloth at 3s. $4\frac{5}{8}$d. per yard, and ſell it again at $\frac{2}{3}$ of a yard for 2s. 10d. what do I gain per cent.?

7—If $\frac{3}{8}$ of a ſhip coſt 1500l. what is the value of $\frac{9}{16}$ of the ſame ſhip?

8—A, B, and C trade together, A advanced $\frac{1}{3}$ of the ſtock, B $\frac{2}{5}$, and C the reſt, they gained 140l. what is each man's ſhare?

DECIMAL

As the Rule of Three in common numbers, and all the following rules depend upon the firſt four rules of arithmetic, viz. Addition, Subtraction, Multiplication and Diviſion; in the ſame manner the Rule of Three and the following rules in Fractions have their dependence upon the rules of Addition, Subtraction, Multiplication, and Diviſion; for which reaſon they need no further illuſtration.

DECIMAL FRACTIONS *.

DECIMAL Fractions have no denominator written to them, it being always underſtood to be an unit with as many ciphers annexed as there are figures in the given decimal, or numerator. They have only a point put before them to diſtinguiſh them from integers; ſo $\frac{5}{10}$ is written thus, .5; $\frac{25}{100}$ thus, .25, and $\frac{725}{1000}$ thus, .725.

Decimal fractions ſuppoſe unity, or the integer to be divided into 10 equal parts, called tenths; and each tenth into ten more, called hundredths; and ſo on, as in the following

TABLE.

Tens of Thouſands &c.	Thouſands	Hundreds	Tens	Units		Tenth	Humdredth	Thouſandth	Ten Thouſandth	Hundred Thouſandth	Millioneth
						Parts					
5	4	3	2	1	.	2	3	4	5	6	
			5	0	.	0	5				
		5	0	0	.	0	0	5			
	5	0	0	0	.	0	0	5			

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* Becauſe decimals are expreſſed in the ſame decuple ratio with integers, decreaſing towards the right hand, viz. 10 ten thouſandth parts make 1 thouſandth part, 10 thouſandth parts make 1 hundredth part, 10 hundredth parts make 1 tenth, 10 tenths make 1, 10 times 1 make 10, 10 times 10 make a hundred, and ſo on: wherefore they will work in all reſpects like whole numbers.

Becauſe decimal fractions increaſe their value towards the left hand in the ſame tenfold proportion with integers they may be annexed to, and worked with integers without any other regard but to the right placing the ſeparating point.

REDUCTION.

REDUCTION teaches to reduce or change vulgar fractions to decimals; the parts of coin, weight, meaſure, &c. to decimals; and to find the value of a decimal in the known parts of the integer.

I. †

To reduce vulgar fractions to decimals.

RULE.

As the denominator of the fraction to its numerator, ſo is 1 with a ſufficient number of ciphers annexed to the decimal required; therefore, annex a competent number of ciphers to the numerator, and divide by the denominator,

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I. †

All fractions may be reduced to decimals to a ſufficient degree of exactneſs, by continuing the diviſion to a ſufficient number of figures; for, if $\frac{9}{16}$ is to be reduced to a decimal of four figures, the denominator is underſtood to be 10000. And, as the denominator of the given fraction to its numerator, ſo is the denominator of the required fraction to its numerator; that is, as 16 : 9 :: 10000 : 5625 the numerator required, which is but annexing four ciphers to the numerator and dividing by the denominator; thus 16)9.0000(.5625; and becauſe the denominator is not written to it, I put a point to make it underſtood, and to diſtinguiſh them from integers.

Sometimes the ſame figure will repeat continually, as in reducing $\frac{2}{3}$, where 2 divided by 3 will give .6666, &c. repeated continually —ſuch decimals are called repetends.

Any fraction having 9 for the denominator will make a repetend of the numerator, as $\frac{4}{9}$ will give .444, &c.

Sometimes

denominator, the quotient will be the decimal required; only obſerve to cut off as many figures for decimals in the quotient as you have taken annexed ciphers in dividing; and if there are not ſo many, prefix ciphers in the quotient till the number of figures be complete.

EXAMPLES.

1—Reduce $\frac{13}{16}$ to a decimal.
2—Reduce $\frac{7}{256}$ to a decimal.
3—Reduce $\frac{3}{2028}$ to a decimal.
4—Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{6}{7}$, $\frac{8}{9}$ and $\frac{9}{10}$ to decimals.
5—Reduce $\frac{1}{3}$, $\frac{1}{6}$, $\frac{4}{9}$, $\frac{2}{6}$, $\frac{5}{12}$ and $\frac{8}{18}$ to decimals.
6—Reduce $\frac{3}{7}$, $\frac{4}{19}$ and $\frac{7}{12}$ to decimals.
7—Reduce $\frac{1}{9}$, $\frac{3}{9}$, $\frac{7}{9}$, $\frac{12}{33}$, $\frac{162}{999}$ and $\frac{28}{333}$ to decimals.

II. ‡

To reduce the leſſer parts of coin, weights, meaſures, &c. to decimals.

Sometimes two, three or more figures will repeat, as $\frac{12}{33}$ will make .363636—ſuch are called circulates, or circulating decimals.

Any vulgar fraction which has only 9 or any number of 9s for the denominator will make a repetend, or circulate of the numerator; ſo $\frac{123}{999}$=.123123, &c. $\frac{3216}{9999}$=.32163216, &c. Hence the value of a repetend may be truly expreſſed in a vulgar fraction, by writing the repeating figures for a numerator, and as many 9s for the denominator. From the foregoing obſervations, the rules or methods for managing repetends and circulates to greater exactneſs, than by the common rules, are derived.

II. ‡

EXAMPLE.—Reduce 13s. 6d. to the decimal of a pound.

```
 s.       s.  d.
 20       13  6
 12       12     l.
 ———      ———
240)      162  (.674
 ————————————————————
or    12)6d.
      —————
      20)13.5s.
      £. .675 as before.
```

13s. 6d. reduced to pence and divided by 1 pound reduced to pence, make .675l. Or 6d. divided by 12 make .5s. to which prefix 13s. make 13.5s. and 13.5s. divided by 20 make .625l. or .625 of a pound. For 13s. 6d. make 162 pence, and 1l. make 240 pence; wherefore 13s. 6d. is $\frac{162}{240}$ of a pound, which is reduced to decimals, as in the firſt caſe.

RULE.

Reduce the given parts to a ſimple quantity, (if need be) which divide by the integer reduced to the ſame name; the quotient will be the decimal required.

Or, reduce the leaſt denomination to the decimal of the next greater, to which prefix the given number of that denomination, and reduce the number ſo compoſed to the decimal of the next greater name, and ſo on, as in common reduction aſcending, till you have brought it to the decimal of the required integer.

EXAMPLES.

1—Reduce 17 ſhillings to the decimal of a pound.
2—Reduce 7 pence to the decimal of a ſhilling.
3—Reduce $10\frac{1}{2}$d. to the decimal of a ſhilling.
4—Reduce 13s. 9d. to the decimal of a pound.
5—Reduce 3 qr. 7lb. to the decimal of a cwt.
6—Reduce 17 ſhillings to the decimal of a guinea.
7—Reduce 3 qr. 3 nails to the decimal of a yard.
8—Reduce 2 roods 17 perches to the decimal of an acre.
9—Reduce 5s. $10\frac{1}{2}$d. to the decimal of a pound.
10—Reduce $7\frac{1}{2}$d. to the decimal of a pound.
11—Reduce 6s. 8d. to the decimal of a pound.
12—Reduce 2 feet 9 inches to the decimal of a yard.
13—Reduce 6 furlongs, 27 poles, 2 yards and 1 foot to the decimal of a mile.
14—Reduce 3 months 2 weeks and 4 days to the decimal of a year.
15—Reduce $\frac{2}{3}$ of an inch to the decimal of a yard.
16—Reduce 3 quarts and 1 pint to the decimal of a hhd.

17—Reduce

To reduce money to the decimal of a pound by inſpection.—Call half the number of ſhillings tenths. 1s.—.05; 6d.—.025, and farthings may be called thouſandth parts, increaſing the number by adding 1 for every 24 farthings; ſo 16s is 8l. 1s. is .05,—6d. is .025 and $2\frac{3}{4}$d. or 11 qr. call .011, theſe added together make 17s. $8\frac{2}{4}$d$=$.8861.

It may be remembered that $\frac{3}{4}=.75$—$\frac{1}{2}=.5$ $\frac{1}{4}=.25$ $\frac{1}{8}=.125$ $\frac{1}{3}=.33\dot{3}$ and $\frac{2}{3}=.66\dot{6}$.

17—Reduce 4 ounces 8 drams to the decimal of a cwt.
18—Reduce 2 drams 16 grains to the decimal of a lb.
19—Reduce 3s. 4d. to the decimal of a mark.

III. ||

To find the value of any given decimal in the known parts of the integer.

RULE.

Multiply as in common reduction, to reduce it to the next lower denomination, then cut off as many figures for decimals in the product as there are in the given decimal, the reſt will be integers: reduce the decimals ſo cut off to the next lower name, and cut off as before; thus proceed till you have brought it to its loweſt terms, and the parts ſignified will be cut off from the decimals.

EXAMPLES.

1—What is the value of .3275l.?
2—What is the value of .01275l.?
3—What is the value of .2735 of a guinea?
4—What is the value of .0735 of a ton?
5—What is the value of .3675 of a mile?
6—What is the value of .2674 of an acre?
7—What is the value of .2375 of a yard?

8—What

III. ||

EXAMPLE.—What is the value of .375 of a pound ſterling?

£375.
20
S. 7.500
12
D.
6.000
Anſwer 12s. 6d.

375l. is $\frac{375}{1000}$, or 375 divided by 1000; wherefore reduce as in compound diviſion, and to cut off three figures for the remainder is dividing by 100.

To value the decimal of a pound ſterling by inſpection, double the tenths for ſhillings, call .05=1s. .025=6d. and every thouſandth part 1 farthing, deducting 1 for every 25, becauſe .025 is but 24 farthings. So to value .886, ſay, .8=16s. .075=1s. 6d, and .011=11 farthings, theſe added together make 17s. 8$\frac{1}{4}$d.

8—What is the value of .7245 of a year?

9—Reduce $\frac{7}{9}$ of a pound to decimals, and find the value thereof.

ADDITION OF DECIMALS.

REDUCE vulgar fractions and the leſſer parts of coin, weight, meaſure, &c. to decimals, and all to one denomination: then write units under units, tens under tens, and decimal parts under like decimal parts.

Add as in whole numbers, and put the ſeparating point under the ſeparating point, viz. cut off as many figures for decimals in the ſum as there are in any of the numbers to be added, that is, make them equal to that which has the moſt *.

EXAMPLES.

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* EXAMPLE.—Add 27l. 13s. 6d., 8.2375l., $3\frac{13}{16}$l., and .2375l. together.

£.27 13 6=£ 27.675
£. 3 $\frac{13}{16}$ =£. 3.8125
8.2375
.2375
£.39 19 3=£.39.8625

The fractions and other parts reduced to decimals.—Write them under one another, tenths under tenths, &c. as in the work,—add them as whole numbers; and becauſe four is the greateſt number of decimal figures in one line, cut off four figures for decimals in the ſum, and the value of 39.9625l. found by the rule in Reduction is 39l. 19s. 3d.

When any of the decimals are repetends, continue them beyond the others, and make them end together: then in adding, increaſe the ſum of the firſt column by as many units as there are nines therein.

$\frac{3}{4}$=.75
$\frac{6}{9}$=.6666
$\frac{8}{9}$=.8888
$\frac{7}{8}$=.875
$\frac{4}{9}$=.4444
3.6350

In the annexed example the repetends continued and ending together—the firſt ſum 18 contains two nines, therefore 2 added to 18 makes 20, ſo that the repetend is 0; wherefore the ſum is finite.

If ſome of the decimals be repetends and others circulates, continue both beyond thoſe that are finite, and till their periods finiſh or end together; then to the ſum of the firſt column add as many as would ariſe to carry if they had been continued further; ſo you will get a circulate in the ſum.

Here

EXAMPLES.

1—Add 127·35, 24.675, 8.34, 287.3 and 4.625 together.

2—What is the ſum of $24\frac{2}{3}$, $17\frac{3}{4}$, 8.3765 and $147\frac{3}{8}$. ?

3—What is the ſum of 2.3725l., 16.375l., $4\frac{9}{16}$l., and 2l. 17s. $8\frac{1}{2}$d. ?

4—What is the ſum of $4\frac{2}{3}$l., $6\frac{7}{9}$l., 13l. 16s. 8d., and 2l. 13s. 4d. ?

5—What is the ſum of 3.725 cwt. 5 cwt. 1 qr. 14 lb. 1.2375 cwt. 1 qr. 17lb. and $23\frac{7}{8}$ cwt. ?

6—Add 27·375 guineas to 43.625l.

SUBTRACTION OF DECIMALS *.

PREPARE your numbers as directed in addition, and write the leſs number below the greater, ſo that parts may ſtand under like parts.

Subtract as in whole numbers; then put the decimal point under the decimal point, viz. cut off as many figures

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$$\begin{array}{r} \frac{3}{4}=.75 \\ \frac{2}{3}=.666666 \\ \frac{23}{99}=.232323 \\ \frac{346}{999}=.346346 \\ \hline 1.99533\dot{6} \end{array}$$

Here they being made to end together, it is eaſy to obſerve, that if they had been continued one figure further there would ariſe 1 to carry to this column; hence the ſum is $1.99533\dot{6}$, where 6 is the laſt figure of the circulate, which without the finite decimal .75 would be $.4533\dot{6}$ for the circulating decimal.

But without regarding the repetends, &c. the common method is ſufficiently exact in buſineſs, if the decimals be carried to five or ſix figures.

* EXAMPLE.—Subtract 37·4628 from 231.12.

$$\begin{array}{r} 231.12 \\ 37.4628 \\ \hline 193.6572 \end{array}$$

This is only writing the parts under like parts, and ſubtracting as in whole numbers, which done, put the point under the point.

$$\begin{array}{r} \frac{3}{4}=.75 \\ \frac{2}{3}=.66\dot{6} \\ \hline \frac{1}{12}=.08\dot{3} \end{array}$$

If one of the numbers be a repetend, continue it out beyond the other.

figures for decimals in the remainder as there are in the given number which has the greater number of decimal figures.

EXAMPLES.

1—Subtract 37.45 from 374.5.
2—Subtract 0.375 from 10.
3—Subtract 24.32735 from 124.336.
4—Subtract 3l. 17s. $10\frac{1}{2}$d. from 11.375l.
5—Subtract $4\frac{7}{9}$ from $10\frac{2}{3}$.
6—Subtract 27.3275 cwt. from 34 cwt. 1 qr. 20 lb.
7—Reduce $\frac{5}{6}$ and $\frac{39}{333}$ to decimals and ſhew their difference.
8—What is the difference between .7345 mile and 5 furlongs 14 poles 2 yards and 1 foot?
9—What is the difference between 17.375 and 8.9465?
10—What is the difference between 12.375 guineas and 16.275l.?

MULTIPLICATION OF DECIMALS.

REDUCE vulgar fractions and the leſſer parts of coin, weight, meaſure, &c. to decimals.

Multiply as in whole numbers, and cut off as many figures for decimals in the product as there are in both factors together.

EXAMPLES.

$\frac{5}{6}=.833\dot{3}$ $\frac{2}{3}=.666\dot{6}$ $.166\dot{6}$	If one or both be repetends, and if there be occaſion to borrow at the firſt figure, borrow 9 inſtead of 10.
$\frac{3}{4}=.75$ $\frac{23}{99}=.2323$ $.5176$	If one or both be circulates, continue them till they end together, and if there would be occaſion to borrow at the preceding figure were they continued further, add 1 to the firſt lower figure.
$1\frac{2}{4}=1.666666$ $\frac{834}{999}=.834834$ $.831831$	

EXAMPLES*.

1—Multiply 374.65 by 27.35.
2—Multiply 13.465 by .3745.
3—Multiply $14\frac{7}{9}$ by $16\frac{2}{3}$.
4—Multiply 3l. 14s. 9d. by .375.
5—Multiply 5l. 19s. 8d. by 3.456.
6—Multiply 2l. 13s. 4d. by $14\frac{1}{2}$.

7—Multiply

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* EXAMPLE.—Multiply 2.734 by 4.35.

$$\begin{array}{r} 2.734 \\ 435 \\ \hline 13670 \\ 8202 \\ 10936 \\ \hline 11.89290 \end{array}$$

This is the ſame as multiplication of whole numbers, only take care to cut off as many figures for decimals in the product as there are in both multiplicand and multiplier together: if there are not ſo many, the number muſt be made up by prefixing ciphers as in the ſecond example.

If the multiplicand be a repetend, add 1 for every 9 in the firſt product, by which you will get a repetend in the product; and if you have ſeveral ſuch products to be added together, continue them till they end together, then add them as ſo many repetends.

If the multiplicand be a circulate, conſider the increaſe that would ariſe to the firſt figure if the multiplicand was continued further; do ſo with each product and make them end together; then conſider the increaſe that would ariſe to the firſt figure of the ſum by the products being continued further.

If the multiplier be a repetend, multiply thereby as in common multiplication, and divide the product by 9 till you get the ſame number of figures in the quotient as there are in the product; which quotient will be the true product: and if there be determinate numbers in the multiplier, write their product under this as uſual.

If the multiplier be a circulate, multiply thereby in the common manner

$$\begin{array}{lr} \text{Multiply} & .375 \\ \text{By} & .004 \\ \hline & .001500 \end{array}$$

$$\begin{array}{lr} \text{Multiply} & 6\frac{2}{3}=66\dot{6} \\ \text{By} & 5 \\ \hline & 33.3\dot{3} \end{array}$$

$$\begin{array}{lr} \text{Multiply} & 8\frac{7}{9}=8.\dot{7} \\ \text{By} & 34.7 \\ \hline & 6144 \\ & 35111 \\ & 263333 \\ \hline & 304.588 \end{array}$$

$$\begin{array}{lr} \text{Multiply} & \frac{37}{99}=.37\dot{3}\dot{7} \\ \text{By} & 246 \\ \hline & 22424 \\ & 149494 \\ & 747474 \\ \hline & 91.9393 \end{array}$$

7—Multiply 16s. 8d. by 36.4.
8—Multiply 27 feet 10½ inches by 8 feet 6 inches.
9—Multiply 4l. 5s. 6d. by 5⅝.
10—Multiply 37$\frac{5}{9}$ by 4⅔.
11—Multiply 7 cwt. 3 qr. 7 lb. by 15⅚.
12—Multiply $\frac{5}{9}$ by ⅔.
13—Multiply 3¾ by .075.
14—Multiply 3¾ by 2s. 6d. a pound the integer.

DIVISION

Multiply 246
By $\frac{2}{3} = .\dot{6}$

$9)1376$

164

Multiply 246
By $14\frac{2}{3} = 14.\dot{6}$

$9)1476$

164.0
984
246

3608.9

ner, and divide by as many 9s as there are figures in the circulate till you get as many figures in the quotient as there were in the product. Or, write the product under itſelf removed as many figures towards the right hand as there are in the circulate, till the laſt figure go paſt the firſt; then the ſum will be the true product exhibiting the circulate.

If there be repetends in both factors, multiply as directed for a repetend in the multiplicand, continuing the products till they end together, then continue the addition to the laſt figure of the firſt product, adding 1 for every 9 in the firſt ſum.

If both factors have circulates, the two rules for circulates muſt be united.

Multiply 243
By $\frac{243}{999} = .\dot{2}4\dot{3}$

729
972
486

59.049
5049

59.09954054

Multiply $23\frac{2}{3} = 23.\dot{6}$
By $17\frac{5}{9} = 17.\dot{5}$

1183
16566
23666

415.47

DIVISION OF DECIMALS.

PREPARE your decimals as directed in Multiplication, and divide as in whole numbers. Cut off as many figures for decimals in the quotient as thoſe in the dividend exceed the number in the diviſor, viz. cut off ſo many in the quotient as make the number in the diviſor equal to the number in the dividend; for there muſt be as many decimal figures in the dividend as there are in both the diviſor and quotient together *.

EXAMPLES.

1—Divide 10246.6775 by 27.35.
2—Divide 1 by .125.
3—Divide 3.7265, by 2784.25.
4—Divide 1l. 8s. $0\frac{3}{8}$d. by .375.

M

5—Divide

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* EXAMPLE.—Divide 46.268 by 2.37.

2.37)46.258(89.52 To divide decimals work exactly as in whole nambers, and cut off as many figures for decimals in the quotient as added to the number in the diviſor will be equal to the number in the dividend. Here becauſe I have taken four decimals in the dividend (reckoning the added cipher) and there are but two in the diviſor, which taken from four, leave two to be cut off in the quotient.

247.5)1.4850(.00 6 Where there are not figures in the quotient equal to the number of decimal

2.475)1485.0(600 figures to be cut off, prefix ciphers till the number is made up.

If there be too few in the dividend continue the diviſion by annexing ciphers till there be as many in the dividend as there are in the diviſor; and though there be no remainder, the ciphers muſt be annexed to the quotient.

If the diviſor and dividend be both repetends, or both circulate , with equal periods, divide as in the common method, and the quotient will be true.

But if they have repetends or circulates annexed to determinate numbers,

24.66) 3746.37(
3746

24.42 3708.91

write

5—Divide 35l. 6s. 8d. by 36.4.
6—Divide 236 feet $11\frac{1}{4}$ inches by 27 feet $10\frac{1}{2}$ inches.
7—Divide $8\frac{1}{21}$ by $4\frac{2}{3}$.
8—Divide $3\frac{3}{4}$d. by 2s. 6d. a pound the integer.
9—Divide 5s. 3d by 2s. 6d. a ſhilling the integer.
10—Divide 24l. 15s. by $5\frac{5}{8}$.

RULE OF THREE IN DECIMALS.

OBSERVE all the directions in the common Rule of Three; only reduce vulgar fractions and the leſſer parts of coin, weight, meaſure, &c. to decimals—Multiply and divide by the rules in decimals *.

EXAMPLES.

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write both diviſor and dividend each under itſelf and removed as many figures towards the right hand as there are figures in the circulate, and ſubtract them; the remainders will be a new dividend and diviſor reſpectively, which will give the true quotient, as may eaſily be proved; for $24\frac{6}{9}$ is $24\frac{66}{99}$, by which divide $3746\frac{37}{99}$, both which multiplied by 99 and divided by 100 (which is the ſame as the foregoing operation) will ſtill give the ſame quotient: for equal parts of, or equal multiples of two numbers will always be in the ſame ratio, and conſequently will give the ſame quotient.

*EXAMPLE.—If $\frac{3}{4}$ yd. of cloth coſt 6s. 6d. what will $17\frac{1}{2}$ yds. coſt?

```
         s. d.  s.
¾=.75   6,,6=6.5   17½=17.5
 y.     s.      y.
.75 : 6.5 :: 17.5
         17.5
        ------
          325
         455
         65
        ------     s.
.75)113.75(151.66
                 12
                ----
                8.00
   Anſwer 7l. 11s. 8d.
```

The fractional parts reduced to decimals, the ſtating made, and the operation performed by the directions in the common Rule of Three, will ſtand as in the annexed work, and the anſwer is 7l. 11s. 8d.

There

EXAMPLES.

1—If $7\frac{1}{2}$ yards coſt 3.25l. what will $47\frac{5}{8}$ yards coſt?

2—If $\frac{2}{3}$ of a ſhilling buy $\frac{7}{9}$ of a lb. how many ounces may be bought for a crown?

3—How much ſtuff $\frac{3}{4}$ of a yard broad, will line $7\frac{3}{4}$ yards of cloth $\frac{7}{8}$ of a yard wide?

4—If 100l. gain 4l. 17s. 6d. in 12 months, what will it gain in $7\frac{3}{4}$ months?

5—In what time will 247.35l. gain as much intereſt as 947l. 17s. will gain in 12 months?

6—If 45l. gain 2.25l. intereſt in 12 months, what will 478l. 15s. 6d. gain in the ſame time?

7—If 100l gain 4l. 10s. intereſt in 1 year, what will one pound gain in the ſame time?

8—How far will a man travel in $7\frac{3}{4}$ days who travels 754 miles in 24 days?

9—If 1 Spaniſh piece of eight be worth 4s. $7\frac{5}{8}$d. what is the worth of $276\frac{3}{8}$ ſuch pieces?

10—If 100l. gain $4\frac{7}{8}$l. in 1 year, what will 784l. 13s. 6d. gain in $7\frac{3}{4}$ years?

11—What ſum of money will gain 27l. 15s. in $3\frac{3}{4}$ years, when 100l. will gain $4\frac{7}{8}$l. in 1 year?

12—If an acre of land be 220 yards long and 22 yards broad, how many acres are in another piece which is $784\frac{1}{2}$ yards long and $236\frac{3}{4}$ yards broad?

13—If 1l. gain $\frac{1}{20}$l. intereſt in 1 year, what will 287l. 15s. gain in 7 years and 8 months?

PROMISCUOUS QUESTIONS.

1—What muſt I multiply 8 by to give 1 in the product?

2—What muſt I divide 1 by to give 4 in the quotient?

3—What number muſt be ſubtracted from $43\frac{1}{2}$ to leave 17.3695 for the remainder?

There being no difference between this and the common Rule of Three, but what is comprehended in the foregoing rules in decimals, there needs no further illuſtration.

4—What number muſt be added to 34.75 that the ſum may be 37.6285?

5—What number multiplied by 3⅞ and the product divided by 7.365 will give 8¾ in the quotient?

6—What will 27.375 yards come to at 7s. 10½d. per yd.?

7—Two men ſet out together from the ſame place, and travel the ſame road, one goes at the rate of 3¼ miles per hour, and the other 3⅔ miles per hour; how far would they be aſunder after 14½ hours travelling, and how long muſt they travel before they are 20 miles aſunder?

8—A grocer bought 46 cwt. 3 qr. 17 lb. at 2l. 16s. per cwt. and 38 cwt. 1 qr. 7 lb. at 2l. 4s. per cwt. which he mixed together and ſold at 7¾d. per lb.; what did he gain or loſe by the whole, and what per cent.?

9—If a board be 10½ inches broad, what length muſt be taken to be equal in meaſure to another board which is 12 inches broad and 7¼ feet long?

10—If I buy 46 yards of cloth for 17l. 17s. 6d. what muſt I ſell it for per yard to gain 18½ per cent?

11—A and B barter, A has 46¾ yards of cloth at 7s. 9d. per yard, B deſires to know how many hats at 3s. 7½d. per piece he muſt give for A's cloth?

12—A, B, and C trade together, A advanced 40l. 15s. B 54l. 10s. and C 62l 16s. they gained 39l. 10s. 3d. what did they gain per £. what per cent. and what is each man's ſhare?

13—If I buy cloth at 6s. 3d. per yard, how muſt I ſell it per yard to gain 15 per cent.?

14—A bankrupt makes a dividend of 68 per cent. what is it per pound?

DUODECIMALS.

A Foot is divided into 12 inches, an inch into 12 parts, a part into 12 ſeconds, a ſecond into 12 thirds, &c. Such parts are Duodecimals or Twelfths.

To multiply Duodecimals, or feet and inches, obſerve, that

Feet

Feet	multiplied by	Feet	produce	Feet
Feet		Inches		Inches
Feet		Parts		Parts
Inches		Inches		Parts
Parts		Parts		Seconds
Inches		Parts		Thirds

EXAMPLES *.

1—Multiply 27 feet 9 inches by 8 feet 6 inches.
2—Multiply 27 feet 10½ inches by 14 feet 9 inches.
3—Multiply 48 feet 7 inches by 8 feet.

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* EXAMPLE.—Multiply 8 feet 7 inches and 4 parts by 5 feet 9 inches and 8 parts.

f.	*i.*	*p.*		
8	7	4		
5	9	8		
43	0	1		
6	5	6	0	
	5	1	10	8
49	11	10	10	9

4 parts multiplied by 5 feet produce 20 parts, or 1 inch and 8 parts; 7 inches by 5 feet produce 35 inches, to which add 1, makes 36 inches or 3 feet; 8 feet by 5 feet make 40 feet, to which add 3 make 43 feet; then 4 parts by 9 inches make 36 feconds or 3 parts; 7 inches by 9 inches produce 63 parts, 63 and 3 make 66 parts, or 5 inches and 6 parts; 8 feet by 9 inches produce 72 inches to which add 5 inches make 77 inches or 6 feet 5 inches; 4 parts by 8 parts produce 32 thirds or 2 feconds and 8 thirds; 7 inches by 8 parts produce 56 feconds to which take 2 feconds make 58 feconds, or 4 parts and 10 feconds; 8 feet by 8 parts produce 64 parts, to which take 4 parts make 68 parts, or 5 inches and 8 parts. Theſe products wrote under one another, as in the example, and added together, make 49 feet, 11 inches, 10 parts, 10 feconds and 8 thirds.

The ſame may be done by taking aliquot parts as in the rules of Practice; thus,

	F.	*I.*	*P.*		
	8	7	4		
	5	9	8		
I.	43	0	9		
6=$\frac{1}{2}$	4	3	8		
3=$\frac{1}{2}$	2	1	10		
6p-$\frac{1}{6}$	0	4	3	8	
2=$\frac{1}{3}$	0	1	5	2	8
F.	49	11	10	10	0

Multiply by 5 feet as before; 6 inches is $\frac{1}{2}$ of a foot, and therefore produces $\frac{1}{2}$ of the multiplicand; 3 inches is $\frac{1}{2}$ of 6 inches, 6 parts is $\frac{1}{6}$ of 3 inches, 2 parts is $\frac{1}{3}$ of 6 parts; theſe parts added together give the ſame product as before.

4—Multiply 23 feet 9 inches 6 parts by 7 feet 8 inches.

5—Multiply 49 feet 7 inches 8 parts by 14 feet 8 inches 6 parts.

6—Multiply 74 feet 6 inches 6 parts by 7 feet 9 inches 4 parts.

7—Multiply 8 feet 7 inches 5 parts by 3 feet 4 inches and 2 parts.

8—Multiply 17 feet 10$\frac{1}{2}$ inches by 3$\frac{3}{4}$ inches.

9—Divide 235 feet 10 inches 6 parts by 27 feet 10$\frac{1}{2}$ inches.

10—Divide 411 feet 1 inch 10$\frac{1}{2}$ parts by 27 feet 10$\frac{1}{2}$ inches.

SIMPLE

Or the parts of a foot may be reduced to decimals, and worked as in multiplication in decimals.

The rule for duodecimals is derived from vulgar fractions; thus,

1 foot by 1 foot evidently produces 1 foot.

1 foot by 1 inch, or or 1 by $\frac{1}{12}$ produce $\frac{1}{12}$ or 1 inch.

1 foot by 1 part, or 1 by $\frac{1}{144}$ produce $\frac{1}{144}$ or 1 part.

1 inch by 1 inch, or $\frac{1}{12}$ by $\frac{1}{12}$ produce $\frac{1}{144}$ or 1 part.

1 inch by 1 part, or $\frac{1}{12}$ by $\frac{1}{144}$ produce $\frac{1}{1728}$ or 1 ſecond.

1 part by 1 part, or $\frac{1}{144}$ by $\frac{1}{144}$ produce $\frac{1}{20736}$ or 1 third. Hence the rule.

And thus may rules for any compound quantities be made.

If a pound be the integer—

1 by 1 pound evidently gives 1l.

1l. by 1s., or 1 by $\frac{1}{20}=\frac{1}{20}$, or 1s.

1l. by 1 penny, or 1 by $\frac{1}{240}=\frac{1}{240}$, or 1 penny.

1s. by 1s., or $\frac{1}{20}$ by $\frac{1}{20}=\frac{1}{400}$l.$=\frac{1}{20}$s.$=\frac{12}{20}$d.$=\frac{3}{5}$d.

1s. by 1d., or $\frac{1}{20}$ by $\frac{1}{240}$—$\frac{1}{4800}$l.$=\frac{1}{240}$s.$=\frac{1}{20}$d.$=\frac{1}{5}$ qr.

1d. by 1d., or $\frac{1}{240}$ by $\frac{1}{240}=\frac{1}{57600}$l.$=\frac{1}{2880}$s.$=\frac{1}{240}$d.$=\frac{1}{60}$ qr.

Wherefore pounds by pounds produce pounds.

Pounds by ſhillings produce ſhillings.

Pounds by pence produce pence.

Shillings by ſhillings produce 20ths of a ſhilling.

Shillings by pence produce 5ths of a farthing.

Pence by pence produce 60ths of a farthing.

Diviſion may be performed as in common diviſion, only multiplying by each quotient figure by the rule of multiplication.

SIMPLE INTEREST BY DECIMALS.

WHEN intereſt remains in the borrower's hands without becoming a part of the principal, or allowing any intereſt for the ſame; ſuch is called ſimple intereſt.

Principal is the money lent.

Rate is the intereſt of 100l. for 1 year.

If the rate be divided by 100, it will give the intereſt of 1l. for 1 year, which is the rate to be made uſe of in the operation by the following rules.

Amount is the ſum of both principal and intereſt.

CASE I*.

Principal, rate and time given to find the amount, or the intereſt.

RULE.

Multiply the principal by the product of the rate and time for the intereſt; or, multiply the principal by the product of the rate and time plus 1, for the amount.

EXAMPLES.

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* EXAMPLE.—At $4\frac{1}{2}$ per cent. how much is it per pound?

As 100 : 4.5 :: 1 : .045 per £. which is only removing the point two figures towards the left hand for the rate to be worked by in all the following rules.

EXAMPLE.—What will 468l. 12s. gain in 1 year at 5 per cent.?

As 1l. : .05l. :: 468.6l. : 23.43l =23l. 8s. 7d. for the anſwer, which is only multiplying the principal by the rate.

EXAMPLE.—What will 64l. 10s. gain in $4\frac{1}{2}$ years at 5 per cent. per annum? viz. If 1l. in 1 year gain .05l. what will 64.5l. gain in 4.5 years;—per the Rule of Three—As 1l. : 1y. : .05l. :: 64.5l. : 4.5y. : 14.5125=14l. 10s. 3d. the anſwer. Which is but multiplying the principal by both the rate and time, or by the product of the rate and time. Add the principal to the intereſt, the ſum is the amount; or add 1 to the product of the rate and time, and multiply the principal by the ſum, this product will be the amount; viz. 64l. 10s. +.14l. 10s. 3d. =79l. os. 3d. or, .05+4.5+1=1.225 and 64l. 10s.×1,225=79l. os. 9d. for the amount required.

EXAMPLE.

EXAMPLES.

1—What intereſt will 274l. 15s. gain in 1 year at 5 per cent. per annum?

2—What will 348l. 10s. gain in 6 years at 5 per cent. per annum, ſimple intereſt?

3—What will 77l. 10s. amount to in 8¾ years at 4½ per cent. per annum?

4—What will 127l. 16s. 6d. amount to in 5 years and 126 days at 4l. 17s. 6d. per cent. per annum?

5—What will 18s. 6d. gain in 124 years and 48 days at 4l. 19s. per cent. per annum, ſimple intereſt?

CASE II.

The amount or intereſt, rate and time given to find the principal.

RULE.

Divide the intereſt by the product of the rate and time; or, add 1 to the product of the rate and time, and divide the amount by the ſum;—the quotient will be the principal.

EXAMPLES.

1—What ſum of money will gain 12l. 7s. 9d. intereſt in 1 year at 5 per cent.?

2—What ſum of money will gain 104l. 11s. ſimple intereſt, in 6 years at 5 per cent. per annum?

3—What

EXAMPLE.—What ſum of money will gain 14l. 10s. 3d. in 4½ years, at 5 per cent. per annum, ſimple intereſt?

As .05l. : 4.5y. : 1l. :: 14.5125l. : 1y. : 64.5l.=64l. 10s. the principal required; which is only dividing the principal by the product of the rate and time.

EXAMPLE.—What ſum will amount to 79l. 0s. 3d. in 4½ years at 5 per cent. per annum, ſimple intereſt?

.05+4.5+1=1.225 the amount of 1l. in 4½ years, then if 1l. amount to 1.225l. what ſum will amount to 79.0125l.—As 1.225 : 1 :: 79.0125 : 64.5, or $\frac{79.0125}{1.225}$=64.5=64l. 10s. the principal required.

EXAMPLE.

3—What ſum of money will amount to 108l. 0s. $3\frac{3}{4}$d. in $8\frac{3}{4}$ years, at $4\frac{1}{2}$ per cent. per annum, ſimple intereſt?

CASE III.

Principal, rate and amount given to find the time.

RULE.

The difference between the principal and the amount is the intereſt. Divide the intereſt by the product of the principal and rate;—the quotient will be the time.

EXAMPLES.

1—In what time will 247l. 15s. gain 12l. 7s. 9d. at 5 per cent. per annum, ſimple intereſt?

2—In what time will 348l. 10s. gain 104l. 11s. at 5 per cent. per annum, ſimple intereſt?

3—In what time will 77l. 10s. amount to 108l. 0s. $3\frac{3}{4}$d. at $4\frac{1}{2}$ per cent. per annum, ſimple intereſt?

CASE IV.

Principal, time and amount, or intereſt, given to find the rate.

RULE.

EXAMPLE.—In what time will 64l. 10s. amount to 79l. 0s. 3d. at 5 per cent. per annum, ſimple intereſt?

79l. 0s. 3d.—64l. 10s.=14l. 10s. 3d. the intereſt, and if 1l. in a year gain .05l. in what time will 64.5l. gain 14.5125l. per the Rule of Three. As 1l. : .05l : 1y. :: 64.5l. : 14.5125l, or $\frac{14.5125\times 1}{64.5\times .05}=4.5$ years, or 4 years and 6 months; which is the intereſt divided by the product of the principal and rate, as per rule.

EXAMPLE.—At what rate of ſimple intereſt will 64l. 10s. amount to 79l. 0s. 3d. in $4\frac{1}{2}$ years?

79l. 0s. 3d.—64l. 10s.=14l. 10s. 3d. the intereſt; then if 64l. 10s. gain 14l. 10s. 3d. in $4\frac{1}{2}$ years, what will 1l. gain in 1 year—per Rule of Three—As 64.5l. : 4.5y. : 14.5125l. :: 1l : 1y. : $\frac{14.5125}{64.5\times 4.5}=.05$ or 5 per cent.; viz. the intereſt divided by the product of the principal and rate—hence the rule.

RULE.

Divide the intereſt by the product of the principal and time;—the quotient will be the rate.

EXAMPLES.

1—At what rate of intereſt will 247l. 15s. gain 12l. 7s. 9d. in 1 year?

2—At what rate of ſimple intereſt will 348l. 10s. gain 104l. 11s. in 6 years?

3—At what rate of ſimple intereſt will 77l. 10s. amount to 108l. 0s. 3¾d. in 8¾ years?

QUESTIONS IN SIMPLE INTEREST.

1—What intereſt will 12465l. 6s. 8d. gain in 1 year at 4¾ per cent.?

2—What ſum of money will amount to 853l. 13s. 2½d. in 7 years at 4l. 5s. per cent. per annum, ſimple intereſt?

3—In what time will 274l. 12s. amount to 371l. 9s. 6.9312d. at 4l. 18s. per cent. per annum, ſimple intereſt?

4—At

When the intereſt of 1l. is found, to multiply it by 100 is but to remove the point again two figures towards the right hand; ſo .05 per £. is 5 per cent. .045 per £. is 4.5 per cent.

The parts of a year reduced to the decimal of a year, and the parts of a pound reduced to the decimal of a pound.—All queſtions in ſimple intereſt may be worked as in the foregoing examples; though many other methods might be pointed out for particular numbers and queſtions; as when the intereſt is 5 per cent. it is $\frac{1}{20}$th of the principal, and parts may be taken for other rates.

The intereſt for calendar months at 5 per cent. is 1 penny per pound per month.

4—At what rate of ſimple intereſt will 716l. 9s. 6d. amount to 723l. 12s. 9.54d. in 73 days?

5—What ſum will gain 296l. 1s. 0¼.6. in 1 year at 4l. 15s per cent.?

6—What ſum will amount to 3536l. 12s. 1¼d. in 7 years at 4.25l. yer cent. per annum, ſimple intereſt?

7—At what rate of ſimple intereſt will 549l. 4s. amount to 742l. 19s. 1d. in 7 years and 73 days.

8—In what time will 716l. 9s. 6d. amount to 729l. 16s. 1.08d. at 5 per cent. per annum, ſimple intereſt?

9—In what time will 6232l. 13s. 4d. gain 592l. 2s. 1d. at 4¾ per cent. per annum, ſimple intereſt?

10—What will 1l. amount to forborn 36 years at 5 per cent. per annum, ſimple intereſt?

11—What ſum will amount to two guineas in 36 years at 5 per cent. per annum, ſimple intereſt?

12—In what time will 100l. amount to 226l. at 4½ per cent. per annum, ſimple intereſt?

13—At what rate of ſimple intereſt will 25l. amount to 68l. 15s. in 50 years?

14—In what time will 35l. amount to 68l. 5s. at the rate of 4l. 15s. per cent. per annum, ſimple intereſt?

15—At what rate of ſimple intereſt will 17s. 6d. amount to 1l. 14s. 1½d. in 20 years?

16—What will 15s. amount to in 56 years at 3l. 19s. per cent per annum, ſimple intereſt?

17—What muſt be paid for the loan of 247l. 14s. for 17 years 2 months and 15 days, at 4¾ per cent. per annum, ſimple intereſt?

COMMISSION, BROKERAGE, REBATE or DISCOUNT, and INSURANCE, &c.

Are all reckoned by the rules of Simple Intereſt.

COMMISSION, BROKERAGE and INSURANCE are all reckoned at ſo much per cent. on a given ſum, as the intereſt thereof for 1 year at a given rate, as in the firſt caſe of ſimple intereſt.

REBATE or DISCOUNT is the ſecond caſe of ſimple intereſt, having the amount, rate and time given to find the principal or preſent worth, and the abatement or intereſt which is called diſcount.

Diſcount is often reckoned by the firſt caſe of ſimple intereſt, calculating the intereſt of the amount or ſum to be diſcounted; but this is a very erroneous method.

EXAMPLES.

1—What is the diſcount on 468l. 10s. for 4 months, reckoning it as intereſt thereon at 5 per cent. per annum?

2—What will be the diſcount for and preſent worth of 127l. 16s. 6d. due in 3 years and 5 months, allowing ſimple intereſt at 5 per cent. per annum?

3—A man owes 560l. payable in 1½ years, is allowed at the rate of 5 per cent. per annum intereſt thereon for diſcount on preſent payment, and borrows a ſum ſufficient to diſcharge the ſame, for which he pays intereſt at the ſame rate? whether does he gain or loſe, and how much?

4—A man owes 240l. to be paid at two four months, that is, half at 4 months, and the other half at 8 months; what is the preſent worth of the whole, allowing diſcount at the rate of 5 per cent. per annum?

5—What is the diſcount on 247l. 10s. for 10½ months, intereſt being at 4⅛ per cent.?

6—How much ready money will pay a debt of 827l. 15s. due at 3 years and 7 months, allowing diſcount at the rate of 5 per cent. per annum?

7—What is the commiſſion on 7246l. at 2½ per cent.?

8—What is the brokerage on goods to the value of 1500l. 15s. at 7s. 6d. per cent.?

9—What does the inſurance of a ſhip and cargo, value 9468l. 10s., come to at 2l. 7s. 6d. per cent.?

10—What is the commiſſion on ſales of goods to the value of 1473l. 10s. at 3¼ per cent.?

COMPOUND INTEREST.

WHEN intereſt is allowed for intereſt remaining in the borrower's hands after it is due, and is added to the principal at the time it becomes due; ſuch is called compound intereſt.

The rate to be uſed in the following rules is the intereſt of 1l. for 1 year.

The amount is the ſum of both principal and intereſt; wherefore the whole intereſt or gain is the difference between the principal and amount.

The amount of 1l. for any number of years not exceeding 10, at 3, 3½, 4, 4¼, 4½, 4¾ and 5 per cent. as exhibited in the following

TABLE OF COMPOUND INTEREST.

	AMOUNT OF £1.						
years	3 pr cent.	3½ pr cent.	4 pr cent.	4¼ pr cent.	4½ pr cent.	4¾ pr cent.	5 pr cent.
¼	1,00741	1.00803	1.00986	1.01046	1.01106	1.61166	1.01227
½	1.01488	1.01735	1.01980	1.02103	1.02225	1.02247	1.02469
¾	1.02242	1.02614	1.02985	1.03171	1.03356	1.03541	1.03727
1	1.03000	1.03500	1.04000	1.04250	1.04500	1.04750	1.05000
2	1.06081	1.07122	1.08160	1.08680	1.09202	1.09723	1.10250
3	1.09272	1.10872	1.12487	1.13299	1.14114	1.14937	1.15762
4	1.12551	1.14753	1.16983	1.18114	1.19252	1.20397	1.31551
5	1.15927	1.18769	1.21665	1.23134	1.24618	1.26116	1.27628
6	1.19405	1.22925	1.26532	1.28664	1.30223	1.32106	1.34010
7	1.22987	1.27227	1.31593	1.33824	1.36086	1.38382	1.40710
8	1.26674	1.31681	1.36857	1.39511	1.42210	1.44554	1.47745
9	1.30476	1.36289	1.42331	1.45440	1.48610	1.51840	1.55132
10	1.34392	1.41060	1.48027	1.51625	1.55297	1.59052	1.62890

CASE I.

The principal, rate and time given to find the amount.

RULE.

Add 1 to the rate, involve the ſum to the power of the time; viz. multiply it by itſelf for 2 years, that product by the ſame for 3 years, &c.; then multiply the principal by the laſt product, and you will have the amount.

Or by LOGARITHMS.

Add 1 to the rate, multiply the logarithm of the ſum by the time, to the product add the logarithm of the principal, and the ſum will be the logarithm of the amount.

By the TABLE.

Find the amount of 1l. for the given time, at the given rate, in the table; but if the time exceed the limits of the table, if you can take two or more ſuch numbers of years in the table that their ſum will be the time, then the products of the correſponding amounts will be the amount of 1l. for the given time: multiply the amount of 1l. (as found in the table) by the principal, and the product will be the amount required.

If you omit 1 or ſubtract 1 from the tabular amount, and multiply the remainder by the principal, you will have the intereſt only.

EXAMPLES *.

1—What will 147l. amount to in 7 years at 5 per cent. per annum, compound intereſt?

2—What

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* EXAMPLE.—What will 46l. amount to in 3 years at 5 per cent per annum, compound intereſt?

$46\times1.05=48.3$
$48.3\times1.05=50.715$
$50.715\times1.05=53.25075$
Or, $46\times1.05\times1.05\times1.05=53.25075$

As by ſimple intereſt—46×1.05 gives the amount of 46l. for 1 year$=50.715$, which multiplied by 1.05 gives the amount of 50.715 for 1 year, and that multiplied by 1.05 gives

2—What will 65l. gain in 7½ years at 5¾ per cent. per annum, compound intereſt?

3—What will 100l. amount to in 34 years at 4½ per cent. per annum, compound intereſt?

CASE II.

Amount, rate and time given to find the principal.

RULE.

Add 1 to the rate, involve the ſum to the power of the time, by which divide the amount; the quotient will be the principal.

Or, add 1 to the rate, divide the amount by the ſum as oft as there are years in the time; the laſt quotient will be the principal.

By LOGARITHMS.

Add 1 to the rate, multiply the logarithm of the ſum by the time, ſubtract the product from the logarithm of the amount, and the remainder will be the logarithm of the principal.

By the TABLE.

Divide the given amount by the tabular amount, and the quotient will be the principal.

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gives 53.35075 the amount for 1 year, which is the amount of 46l. for 3 years. Or, 1.05×1.05×1.05×46=53.25075=53l. 5s. 0.18, the amount required.

In the table the amount of 1l. for 3 years at 5 per cent. is 1.15762, which multiplied by 46 gives 53.25 the amount as before.

If the amount of 46l. for 17¼ years was required, the tabular amount for 10 years is 1.6289, for 7 years 1.47745, and for ¼ year 1.03727, wherefore 1.6289×1.47745×1.03726×46, will give the amount of 56l. for 17¼ years.

EXAMPLE—What ſum of money will amount to 53. 5s. 0.18 in 3 years at 5 per cent. per annum, compound intereſt?

This is juſt the reverſe of the former caſe; for if 53.25075 be divided by 1.05 it will give the laſt year's principal, which divided again

EXAMPLES.

1—What ſum will amount to 206l. 16s. 10½d. in 7 years, at 5 per cent. per annum, compound intereſt?

2—What ſum of money will gain 26l. 19s. 4½d. intereſt in 7½ years, at 4¾ per cent. per annum, compound intereſt?

3—What ſum of money will gain 346l. 12s. 9¼d. intereſt in 34 years, at 4½ per cent. per annum, compound intereſt?

CASE III.

Principal, rate and amount given to find the time.

RULE.

Add 1 to the rate, divide the amount by the ſum continually, till the quotient is leſs than the diviſor: the number of diviſions will be the number of years, then divide the laſt quotient by the ſame diviſor, and this quotient will be the parts of a year.

By LOGARITHMS.

From the logarithm of the amount ſubtract the logarithm of the principle, divide the remainder by the logarithm

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again by 1.05 will give the laſt but one, and ſo on; wherefore,

$$\frac{53.25075}{1.05 \times 1.05 \times 1.05}$$

or 53.25075 divided by the third power of 1.05 gives 56l. the principal required.

Or, as 1.15762 the tabular amount is to 1, ſo is 51.25075 the given amount to 46l. the principal required; which is but dividing 53.25075 by 1.15762.

If the time exceed the limits of the table, find the amount of 1l. as directed in the firſt caſe.

EXAMPLE.—In what time will 46l. amount to 53.2507 at 5 per cent. per annum, compound intereſt?

Divide 53.2507 by 46, the quotient 1.15762 is the amount of 1l. for the ſame time, which divided by 1.05 gives 1.1025, and 1.1025 divided by 1.05 gives 1.05, and 1.05 divided by 1.05 gives 1; here the number of diviſions being 3, the time is 3 years.

Or, 1.15762 is found in the table, under the rate againſt 3 years.

EXAMPLE.

logarithm of the rate plus 1; the quotient will be the time.

By the TABLE.

Divide the amount by the principal; then under the rate the quotient will be found againſt the time.

EXAMPLES.

1—In what time will 147l. amount to 206l. 16s. 10½d. at 5 per cent. per annum, compound intereſt?
2—In what time will 65l. gain 26l. 19s. 4½d. at 4¾ per cent per annum, compound intereſt?
3—In what time will 100l. amount to 446l. 12s. 9¼d. at 4½ per cent. per annum, compound intereſt?

CASE IV.

Principal, time and amount given to find the rate.

RULE.

Divide the amount by the principal, the root of the power of the time of the quotient will be the rate plus 1.

By LOGARITHMS.

From the logarithm of the amount ſubtract the logarithm of the principal, divide the remainder by the time, the quotient will be the logarithm of the rate plus 1.

By the TABLE.

Divide the amount by the principal, the quotient may be found in the table againſt the time under the rate.

EXAMPLE.—At what rate of compound intereſt will 46l. amount to 53.25075 in 3 years?

53.25075 divided by 46 gives 1.15762 the amount of 1l.; the cube root of which is 1.05; or by any method find a number by which dividing 1.15762 three times will have no remainder—that number 1.05 ſhews the rate to be 5 per cent.

Or, 1.15762 found in the table againſt the time, is under the rate 5 per cent.

EXAMPLES.

1—At what rate of compound intereſt will 147l. amount to 206l. 16s. $10\frac{1}{2}$d. in 7 years?

2—At what rate of compound intereſt will 65l. gain 26l. 14s. $4\frac{1}{2}$d. in $7\frac{1}{2}$ years?

3—At what rate of compound intereſt will 100l. amount to 446l. 12s. $9\frac{1}{4}$d. in 34 years?

ANNUITIES.

AN Annuity is a yearly payment, as of rent, intereſt or penſion, &c.: the value of which either at the beginning or end of a given time may be found according to compound intereſt, by firſt finding a principal, the intereſt whereof will be equal to the annuity; thus,

Divide the annuity by the rate per cent.; the quotient will be the principal required.

The intereſt of that principal will be the amount of the annuity.

The preſent worth of that amount is found by the ſecond caſe in compound intereſt *.

EXAMPLES.

1—What ſum muſt be put out to intereſt to pay an annuity of 47l. 10s. at 5 per cent. per annum?

2—What

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* EXAMPLE.—What will 15l. per annum amount to in 6 years, at 5 per cent. per annum, compound intereſt?

As .05 : 1 :: 15 : 300; viz. the intereſt of 300l. will pay the annuity, and by the firſt caſe in compound intereſt, the intereſt of 300l. is 102l. 0s. 7.2 the amount of the annuity: and if the preſent worth be required, the preſent worth of 102l. 0s. 7.2 bv the ſecond caſe, will be found to be 76l. 1s. $2\frac{1}{4}$d. and ſo much will purchaſe an annuity of 15l. per annum, to continue 6 years.

EXAMPLE.—What annuity forborn 6 years at 5 per cent. per annum, will amount to 102.03l.?

The principal which will gain 102.03l. in 6 years, by the ſecond caſe in compound intereſt is 300l. the yearly intereſt of which is 15l. the annuity required.

EXAMPLE.

2—What will an annuity of 47l. 10s. amount to in 7 years at 5 per cent. per annum, compound intereſt?

3—What is the preſent worth of an annuity of 47l. 10s. to continue 7 years at 5 per cent. per annum, compound intereſt?

4—What annuity forborn 7 years will amount to 386l. 14s. 10.8 at 5 per cent. per annum. compound intereſt?

5—What annuity to continue 7 years at 5 per cent. per annum, compound intereſt, will 274l. 2s. 10½d. purchaſe?

6—How long muſt an annuity of 47l. 10s. continue to amount to 386l. 14s. 11d. when compound intereſt is allowed at 5 per cent. per annum?

7—A man purchaſed an annuity of 47l. 10s. for 274l. 2s. 10½d.; how long muſt it continue to be worth the purchaſe, when compound intereſt is reckoned at 5 per cent. per annum?

8—If an annuity of 47l. 10s. to continue 7 years, be worth 274l. 2s. 10½d.; what is the rate of compound intereſt?

9—If an annuity of 47l. 10s. in 7 years amount to 386l. 14s. 11d., what is the rate of compound intereſt?

QUESTIONS

Example.—What annuity to continue 6 years will 76l. 1s. 2¼d. purchaſe, allowing compound intereſt at 5 per cent per annum?

Find what 76l. 1s. 2¼d. will amount to in 6 years at 5 per cent., then find what ſum will gain that amount in the ſame time,—the yearly intereſt of this ſum will be the annuity.

Example.—How many years muſt an annuity of 15l. continue to amount to 102.03l. reckoning compound intereſt at 5 per cent. per annum?

This is the ſame as to find in what time 300l. will gain 102.03l. at 5 per cent.

Example.—At what rate of compound intereſt will an annuity of 15l. amount to 102.03l. in 6 years?

Divide the amount 102.03l. by the annuity 15, from the quotient 6.8 ſubtract 1, then the remainder 5.8 found in the table as follows; viz. the column in which the amount for 1, 2, 3, 4, and 5 years (1 year leſs than the given time) added together make 5.8, ſhews the rate, which is here 5 per cent.

QUESTIONS
IN
COMPOUND INTEREST.

1—If 27l. 15s. be forborn 15 years, what will it then amount to, reckoning compound intereſt at 5 per cent. per annum?

2—What intereſt will 55l. 10s. gain in 15 years at 5 per cent. per annum, compound intereſt?

3—If an annuity of 25l. 10s. per annum be unpaid 7$\frac{3}{4}$ years, what will then be due, allowing compound intereſt at 5 per cent. per annum?

4—How long muſt an annuity of 38l. 5s. be forborn to amount to 351l. 11s. reckoning compound intereſt at 5 per cent. per annum?

5—What ſum muſt be lent at 4$\frac{1}{2}$ per cent. per annum, compound intereſt, to amount to 100l. in 6 years?

6—A man dying left his ſon 100l. to be paid to him when it amounts to 150l. at 4$\frac{1}{2}$ per cent. per annum, compound

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THEOREMS FOR COMPOUND INTEREST.

Put p=the principal, r= the rate or amount of 1l. for 1 year, t= the time, g= the total intereſt or gain, and a= the amount.

then $pr^t = a$.

$$pr^t - p = p \times \overline{r^t - 1} = g.$$

$$\frac{a}{r^t} = p, \text{ or } \frac{g}{r^t - 1} = p.$$

$$\frac{a}{p} = r^t. \therefore \sqrt[t]{\frac{a}{p}} = r.$$

$$\sqrt[t]{\frac{g}{p} + 1} = r.$$

FOR

compound intereſt—How long after the father's death muſt the ſon receive his legacy?

7—A perſon would purchaſe an annuity of 25l. per annum, to continue 6 years; what is it worth when compound intereſt is allowed at 4½ per cent. per annum?

8—A perſon lent 111l. and at the end of 15 years he received 230l. 15s. 2¾d. for principal and intereſt; what rate of compound intereſt did he receive?

9—Whether will 240l. lent for 7 years at 4 per cent. per annum, compound intereſt, or lent for the ſame time at 5 per cent. per annum, ſimple intereſt, gain more, and how much?

10—A perſon has a perpetual income of 27l. 10s. per annum, which he would ſell for a life annuity; what annuity ought he to receive, allowing compound intereſt at 5 per cent. and his life valued at 14 years?

11—A

FOR ANNUITIES.

Put u = the annuity, a = the amount thereof, r = the rate or amount of 1l. for 1 year, t = the time, p = the preſent worth.

then $$\frac{ur^{t}}{r-1} - \frac{u}{r-1} = \frac{ur^{t} - u}{r-1} = a$$

$$\frac{u}{r-1} - \frac{u}{r.} = p = \frac{ur^{t} - u}{r^{t} \times r-1}$$

$$\frac{a \times \overline{r-1}}{r^{t} - 1} = \frac{p\, r^{t} \times \overline{r-1}}{r^{t} \times r-1} = u$$

$$\frac{ar-a}{u} + 1 = r^{t}.$$ Here the root t extracted will give r, or divided continually by r till the quotient is leſs than r, the number of diviſions will be the number of years: or the logarithm of r^{t}. divided by t will give the logarithm of r, or divided by the logarithm of r will give t.

11—A perſon takes a farm for 12 years on which he lays out 260l. in improvements, which he finds will pay him 7 per cent.; what is the preſent worth of his gain or loſs?

12—Whether is more advantageous to give 1200l. for an eſtate, or to take a leaſe thereof for 21 years at 42l. per annum, and how much, when intereſt is reckoned at $4\frac{1}{2}$ per cent. per annum?

ARITHMETICAL PROGRESSION.*

WHEN a rank or ſeries of numbers have one common difference, they are ſaid to be in Arithmetical Progreſſion.

The greateſt number is called the greater extreme.

The leaſt number is called the leſs extreme.

The common difference is called the ratio, or common exceſs.

The middle term is called the mean.

Double the mean is equal to the ſum of the two extremes, or to the ſum of any two terms equally diſtant from the mean.

The common difference multiplied by one leſs than the number of terms, gives the difference between the extremes.

The ſum of the extremes multiplied by half the number of terms, gives the ſum of all the terms, or ſeries.

The ſum of any number of the odd terms 1, 3, 5 7, 9, &c. will be a ſqare number.

EXAMPLES.

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* 3, 7. 11, 15, 19, 23, 27.—Here 3 the firſt term is the leſs extreme, and 27 the laſt term or greater extreme, and 15 the mean or middle term;—and $15\times2=11+19=7+23=3+27=30$: wherefore $30\times\frac{7}{2}$, or $\frac{30}{2}\times7=105=3+7+11+15+19+23+27$.

The difference of the extremes, viz. 27—3, divided by 1 leſs than the number of terms, 7—1; is $\frac{24}{6}=4$ the common difference.

$1+3=4=$ the ſquare of 2, $1+3+5=9=$ the ſquare of 3; wherefore the ſum of the ſeries 1, 3, 5 7, &c. is the ſquare of the number of terms.

EXAMPLES.

1—A man made ſeven payments, the greateſt was 23l. and the leaſt 3l.; they had all a common difference: how much did they amount to?

2—A man had ſix ſons, whoſe ages were in arithmetical progreſſion, the oldeſt was 23 years old, and the youngeſt 8; what was their common difference?

3—A man is to make 8 payments, the firſt 4l. the ſecond 6l. and each payment is to exceed the former by 2l.; what muſt be the laſt payment, and how much is the ſum of all the 8 payments?

4—If 100 eggs be placed in a right line at the diſtance of 1 yard from one another, and the firſt 1 yard from a baſket; how far muſt a man travel to fetch them one by one into the baſket?

5—A man has a debt to diſcharge in 1 year by weekly payments. the firſt week he is to pay 1s. the laſt week 7l. 14s., the differences between the payments are equal; he wants to know what the common difference is, and what the whole amounts to?

GEOMETRICAL PROGRESSION.

WHEN a ſeries or rank of numbers are produced by a continual multiplication or diviſion. it is called a geometrical ſeries.

The common multiplier is called the ratio.

The greateſt and leaſt terms are called the extremes.

The ſquare of the mean or middle term is equal to the product of the two extremes, or to any two terms equally diſtant from the mean.

The product of any two terms is equal to the product of any other two terms equally diſtant from the former, and taken one one ſide and the other on the other ſide.

If three terms be in geometrical proportion, the firſt is to the ſecond as the ſecond is to the third.

In any geometrical progreſſion deſcending when the ratio is 2, double the firſt term is equal to the ſum of all the terms in infinitum.

In any geometrical progreſſion where the ratio is 2, the leaſt term ſubtracted from twice the greateſt will leave the ſum of all the terms.

In any geometrical progreſſion decreaſing, the greateſt term multiplied by the ratio and divided by 1 leſs than the ratio, will give the ſum of all the terms in infinitum.

In any geometrical progreſſion, the greateſt term multiplied by the ratio, the leaſt term ſubtracted from the product, and the remainder divided by 1 leſs than the ratio, will give the ſum of all the terms.

In any geometrical progreſſion proceeding from unity, the ſqare of any term is a term doubly diſtant from the firſt, and the product of any two terms is a term as far diſtant from the firſt as is equal to the ſum of the diſtances of the two terms *.

EXAMPLES.

1—There are three terms in geometrical progreſſion, the extremes are 16 and 64, what is the mean?

2—There are three terms in geometrical proportion, the firſt is 9 and the mean is 12, what is the third?

3—What will a horſe coſt by doubling the nails in his ſhoes, which are 32, with a farthing?

4—There is a geometrical ſeries in which the fifth term from unity is 32, and the ninth 312, what is the fourteenth?

5—What is the ſum of the ſeries 64, 32, 16, 8, &c. continued to infinitum?

6—What

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* In the geometrical ſeries 3, 9, 27, 81, 243, 729, the ratio or common multiplier is 3.—As 3 : 9 :: 9 : 27 or 3 : 9 :: 27 : 81. and 81 × 81 = 243 × 27 = 729 × 9.

The ſum of the ſeries 16, 8, 4, 2, ½, &c. to infinitum = 16 = 2 = 32; for it may be ſeen, that the ſum of any number of terms wants only the laſt of being double the firſt, therefore when the laſt is reduced to 0, the ſum will be double the firſt: for the ſum of 64, 32, 16 and 8 = 64 × 2—8 = 120.

In the ſeries 729, 243, 81 and 27 continued to infinitum, the ſum is 729 × ½ = 1093½—but if the ſeries terminate at 8, then 729 × 3—27 ÷ 2 = 1080, and ſo of any other.

6—What is the ſum of the ſeries 2187, 729, 243, &c. continued to infinitum?

7—What is the ſum of the ſeries 256, 64, 16, &c. continued to infinitum?

8—What is the ſum of the ſeries 1024, 512, 256, &c. continued to 32?

9—What is the ſum of the ſeries 1024, 256, 64, &c. continued to 4?

10—What is the ſum of the ſeries 1, 2, 4, 8, &c. continued to 24 terms?

11—What is the ſum of 12 terms of the ſeries 7, 21, 63, 189, &c.

ALIGATION.

ALIGATION teaches to mix ſimples, and aſcertain the mean price—To find the proportional quantities of ſimples to bear a given price—The quantities of ſimples to be mixt with a given quantity of one of them, to bear a given price—Alſo to make a mixture of a given quantity and price.

I *.

Having the price and quantity of each ſimple given to find the price of the mixture.

RULE.

Multiply each quantity by its price, and divide the ſum of the products by the ſum of the quantities; the quotient will be the price of the mixture.

1—A

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* EXAMPLE.—If 16 lbs. of ſugar at 4d. 12 lb. at 5d. and 28 lb. at 7d. per lb. be mixed together, what is the price of a pound of this mixture.?

lb. *d.* *d.*
16×4= 64
12×5= 60
28×7=196
56)320($5\frac{1}{4}$d. nearly.

The price multiplied by the quantity gives the value of that quantity, and the ſum of thoſe products is the value of the whole; which divided by the total quantity gives the price, which is $5\frac{1}{4}$d. nearly, as in the work.

EXAMPLE.

EXAMPLES.

1—A vintner would mix 8 gallons of wine at 5s. 6d. per gal. with 6 gals. at 5s. per gal., 12 gals. at 4s. 6d. per gallon, and 5 gallons at 4s. per gallon, and deſires to know the price of a gallon of this mixture?

2—A tobacconiſt mixes 4 lbs. of tobacco at 18d. per lb. with 9 lb. at 12d., 7½ lb. at 10d., 16 lb. at 9½d., and 12½ lb. at 8d.; what is the price of a pound of the mixture?

3—Having mixed 24 gallons of ale at 10d. per gallon, 16 gallons at 9d., 12 gallons at 8½d., and 10 gallons at 8d. per gallon; what is the value of a gallon of this mixture?

II.

Having the price of each ſimple and that of the mixture given to find each quantity.

RULE.

Write the prices in two columns, thoſe which are below the mean in one column, and thoſe which are above it in the other; find the difference between the price of the mean and that of each ſimple, which write againſt the price which ſtands oppoſite to it in the other column, for the quantity at that price; thus do with every price, and you will have the quantities.

EXAMPLES.

1—A grocer hath ſpices, ſome at 9d. ſome at 24d. and ſome at 30d. per lb. how much of each ſort muſt he take to make a mixture worth 20d. per lb.?

2—A

EXAMPLE.—A grocer would mix ſugars at 4d. 6d. 10d. 12d. and at 14d. per lb. and deſires to know how much of each ſort he muſt take to ſell the mixture at 8d. per pound?

| 8d.
2 lb. at 4d | 4 lb. at 10d.
6+4 —— 6 | 2 —— 12
| 2 —— 14

The difference between 4d. and 8d. is 4d.; then 4 lb is the quantity at 10, between 6 and 8 is 2, write 2 lb. againſt 12d., between 10d. and 8d. is 2d., write 2 lb. againſt 4d. between 12d. and 8d. is 4d., write 4 lb. againſt 6d., and between 14d. and 8d. is

d6.,

2—A vintner has canary at 26d. per quart, ſherry at 20d. and malaga at 15d. per quart; how much of each ſort muſt he take to make a mixture to ſell at 19d. per quart?

3—How much wine at 10s. and at 7s. per gallon muſt be mixed together to ſell at 8s. per gallon?

4—How much corn at 3s. at 4s. 6d. at 5s. at 6s. 6d. and 7s. per buſhel, to make a mixture worth 6s. per buſhel?

III.

When the price of each ſimple and the quantity of one of them, together with the price of the mixture are given to find the other quantities.

RULE.

Find the quantities by the ſecond caſe; then as the quantity ſo found, of which the quantity is given, to the ſaid given quantity; ſo is each of the other quantities ſo found, to each of the quantities required.

EXAMPLES.

1—A farmer would mix barley at 3s. per buſhel, peaſe at 4s. 6d. per buſhel, oats at 5s. per buſhel, and rye at 6s. 6d. per buſhel, with 12 buſhels of wheat at 7s. per buſhel; how much of each ſort muſt he take to ſell a buſhel at 6s.?

6d., write 6 lb. againſt either of 4d. or 6d., and the difference between 4d. or 6d. and 8d. is the mean to be written againſt 14d.; ſo when two differences are written againſt one price they muſt be added together; ſo $6\times4=10$ lb. at 6d.

This may be proved by the firſt caſe.

Queſtions in this rule admit of as many anſwers as orders of writing the prices in one of the columns.

The reaſon of this rule may be underſtood by conſidering, that if two quantities be in proportion to one another, as the differences between their prices and the mean, the differences between their values and the mean value will be equal, at 7d. and 1 d. per lb. the mean 9d. the differences are 3 and 2, and 3 lb. at 2d. is equal to 2 lb. at 3d.

2—A grocer has 46 lbs. of ſugar at 14d. per lb. which he would mix with ſome at 12d. ſome at 9d. ſome at 7d. and ſome at 6½d. per lb.; how much of each ſort muſt he take to ſell the mixture at 10d. per lb.?

3—A vintner has 13 gallons of wine at 9s. per gallon, and deſires to know how much at 7s. at 5s. and at 3s. 6d. per gallon he muſt take to make a mixture to ſell at 7s. 6d. per gallon?

IV.

Having the price of each ſimple, the price of the mixture, and the total quantity given to find each quantity reſpectively.

RULE.

Find the quantities by the ſecond caſe, add them together, and ſay, as the ſum is to the total quantity given, ſo is each quantity ſo found, to the quantity required.

EXAMPLES.

1—A tobacconiſt has tobacco at 2s. 4d. per lb. at 2s. 2d. at 2s. per lb. at 20d. per lb. at 18d. per lb. and at 19d. per lb. of which he would make a mixture of 1cwt. to ſell at 22d. per lb. how much of each ſort muſt he take?

2—A vintner has wine at 8s. per gallon, which he would mix with cyder at 1s. 2d. per gallon; how much of each muſt he take to fill a pipe of 126 gallons to ſell at 6s. per gallon?

3—A

The anſwer being found by the former caſe, it is evident, that if the quantities be ſtill in the ſame proportion, the mean price will be ſtill the ſame: wherefore, as one of the quantities ſo found is to any propoſed quantity thereof, ſo is each of the quantities found as before, to the quantity thereof to be mixed with the propoſed quantity.

The quantities being found by the ſecond caſe and added together, it is evident that they will bear the ſame proportion to one another when each is made to have the ſame proportion to the propoſed quantity, which it had to the ſum of the quantities ſo found.

3—A grocer has ſpices at 20d. at 16d. at 14d. and at 12d. per lb.; how much of each ſort muſt he take to make a mixture of 56lb. worth 15d. per lb.?

4—A tea dealer has an order for 120lb. of tea at 6s. 6d. per lb. but having none of that price he would mix ſome at 10s. ſome at 8s. ſome at 6s. ſome at 5s. and ſome at 4s. 6d. per lb; how much of each ſort muſt he take?

SQUARE ROOT.

WHEN a number is multiplied by itſelf it produces the ſquare or ſecond power of that number, and the number itſelf is called the root of that ſquare, ſo 4×4 produces 16, ſo 16 is the ſquare of 4, and 4 is the ſquare root of 16.

8×8=64 the ſquare of 8, and 8 is the ſquare root of 64.

A root of a ſingle figure is found by inſpection.

To extract or find the ſquare root conſiſting of more figures than one.

RULE.

Make a point over units figure and every ſecond figure by which the given ſquare will be pointed into periods of two figures each, except the firſt, which will ſometimes have but one, the units figure muſt always be the latter figure in its period.

Find the greateſt root in the firſt period which write in the quotient or root, and the ſquare thereof, under the ſaid period; ſubtract it therefrom: to the remainder annex the next period for a dividend; double the quotient for a diviſor; aſk how oft the diviſor is contained in the dividend, with the conſideration that the anſwer muſt be the units figure of the diviſor: write the anſwer in the quotient. alſo in the units place of the diviſor; then multiply the diviſor by the ſaid laſt quotient figure; write the product under the dividend, and ſubtract it therefrom: to the remainder annex the next period for a new dividend, with which proceed as before; thus do with every period, and if there is ſtill a remainder, you may take pairs of cyphers for additional periods till you have a ſufficient number of decimals in the root.

The periods which are integers give integers, and the decimal periods give decimals in the root *.

EXAMPLES.

1—What is the ſquare root of 144?
2—What is the ſquare root of 576?
3—What is the ſquare root of 5184?
4—Extract the ſquare root of 20736.
5—Extract the ſquare root of 186614.
6—Extract the ſquare root of 746456.
7—What is the ſquare root of 29858.24?
8—What is the ſquare root of 2746.5891?
9—What is the ſquare root of 37. 5?
10—What is the ſquare root of 794367.253?
11—What is the ſquare root of 38476.2736?
12—What is the ſquare root of 726.37964?
13—Extract the ſquare root of 3.47283.
14—Extract the ſquare root of 7.
15—Extract the ſquare root of 2.
16—Extract the ſquare root of .734268.

17—Extract

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* EXAMPLE.—What is the ſquare root of 1296.?

```
  .  .
1296(36 root.
 9
------
66)396
   396
------
     0
```

Having pointed 1296 into periods of two figures by the rule, as in the example. The greateſt root of 12 is 3, which write in the root or quotient, then the ſquare of 3 or 3 times 3 is 9; write 9 under 12 and ſubtract, to the remainder annex 96 makes 396 for a dividend. The quotient 3 doubled is 6 for the diviſor—How oft 6 in 39? Anſwer, 6 times: write 6 in the quotient or root, alſo in the units place of the diviſor makes 66, which multiplied by 6 makes 396; ſo there will be no remainder, and 36 is the required root, for 36×36=1296, which proves the work.

Take care to point your given ſquare into periods, ſo that the decimal point may be between the periods, and always double the whole quotient for a diviſor, &c.

Of a vulgar fraction—If you can extract the root of both numerator and denominator without a remainder, you will get the true root, otherwiſe it is beſt to reduce it to a decimal.

17—Extract the ſquare root of .57283.
18—What is the ſquare root of .034762?
19—What is the ſquare root of .07235?
20—What is the ſquare root of .002374?
21—What is the ſquare root of .00573?
22—What is the ſquare root of $\frac{16}{25}$?
23—What is the ſquare root of .0007?
24—What is the ſquare root of .00037?
25—What is the ſquare root of 2000, of 200, of 20, of 2, of .2, of .02, of 002 and of 0002?
26—What is the ſquare root of $\frac{150}{216}$, of $\frac{3}{4}$, of $\frac{7}{8}$, of $\frac{64}{81}$ of $\frac{256}{729}$, of $\frac{36}{99}$ and of $\frac{237}{999}$.

OF THE CUBE ROOT.

If the ſquare be multiplied again by its root, the product is the cube of third power of that root; ſo 4×4×4 =64: wherefore 64 is the cube of 4, and 4 is the cube root of 64.

To find a cube root of ſeveral figures.

RULE.

Point your given cube into periods of three figures, the units figure being the laſt in its period.

Find the greateſt cube root in the firſt period, which, write in the root and its cube under the firſt period, ſubtract and annex the next period to the remainder for a dividend.

Multiply the ſquare of the quotient by 300 for a diviſor. Aſk how often the diviſor in the dividend, and write the anſwer in the root.

Multiply the diviſor by the laſt figure in the root.

Multiply the ſquare of the laſt figure in the root by the reſt of the root, and by 30.

Cube the laſt figure in the root.

Add the three laſt found numbers together, and ſubtract their ſum from the dividend; to the remainder annex the next period for a new dividend, with which proceed as before; thus do with every period, and if there is ſtill a remainder, take three ciphers for an additional period, and ſo on, till you have a competent number of decimals in the root *.

EXAMPLES.

1—What is the cube of 16?
2—What is the cube root of 13824?
3—What is the cube root of 110592?
4—Extract the cube root of 884736.
5—Extract the cube root of 707 7888.
6—What is the cube root of 56623104?
7—What is the cube root of 452884832?
8—What is the cube root of 3623078656?
9—What is the cube root of 1472836729?
10—What is the cube root of 79635.28?
11—What is the cube root of 3264.79246?
12—What is the cube root of 3000, of 300, of 30, of 3, of .3, of 03, of 003, of .0003, and of .00003?
13—What is the cube root of $\frac{27}{64}$, of $\frac{24}{32}$, of $\frac{75}{648}$, of $\frac{7}{8}$, and of $\frac{23}{99}$?

---

* **EXAMPLE.**—What is the cube root of 13824?

```
        .  .
       13824(24
        8
      --------
1200)  5824
      --------
       4800
        960
         64
      --------
       5824
       ----
          0
```

The given cube 13824 pointed into periods of three figures by the rule. The greateſt root in the firſt period is 2, the cube of which is 8, which ſubtracted from 13 leaves 5, to which annex 824 makes 5824 for the dividend; then 2×2×300=1200 for the diviſor—How oft 1200 in 5824? Anſwer, 4 times; then 4 times 1200 is 4800—4×4×2×30=960, 4×4×4=64. theſe added together, and the ſum ſubtracted from the dividend leaves no remainder; ſo 24 is the true root, for 24×24×24=13824, which proves the work.

Sometimes the remainder will be more than the diviſor.

Take care that the decimal point be betwixt two periods, which muſt be obſerved in extracting all kinds of roots.

ROOT OF THE FOURTH POWER.

IF the cube be multiplied by its root, or the ſquare ſquared, it produces the fourth powers: ſo 4×4×4×4 =256 the fourth power of 4, and 4 is the root of the fourth power of 256.

To extract the root of the fourth power.

RULE.

Extract the ſquare root of the ſquare root, and you will have the root of the fourth power. Or,

Point your given number into periods of four figures: find the greateſt root in the firſt period, which write in the root, and the fourth power thereof under the ſaid period; ſubtract and annex the next period to the remainder for a dividend.

Multiply the cube of the root by 4000 for a diviſor. Aſk how oft the diviſor is contained in the dividend and write the anſwer in the root.

Multiply

---

* **Example.**—What is the root of the fourth power of 1679616? The ſquare root of 1679616 is 1396, and of 1296 is 36 the root of the fourth power.

```
          .   .
        1679616(36 the root.
         81
        -------
 108000)869616
        --------
        648000
        194400
         25920
          1296
        -------
        869616
        ------
```

The given number being pointed into periods of four figures each, the greateſt root in the firſt period is 3, and the fourth power thereof is 81, which ſubtracted from 167 the firſt period, leaves 86, to which annex the next period 9616 for a dividend; then 3×3×3× 4000=108000, for a diviſor—How oft 108000 in 869616? Anſwer, 6 times, which write in the root; then 108000×6=648000, then 6×6×3 ×3×600=194400, and 6×6×6×3×40=25920; alſo 6×6×6× 6=1296

Multiply the diviſor by the laſt figure in the root—multiply the ſquare of the laſt figure by the ſquare of the reſt, and by 600—multiply the cube of the laſt figure by the reſt and by 40.

Involve the laſt figure to the fourth power. Subtract the ſum of theſe four numbers from the dividend; to the remainder annex the next period for a new dividend, with which proceed as before, and repeat the operation till nothing remain, or till you have a competent number of decimals in the root.

EXAMPLES.

1—What is the fourth power of 16
2—Extract the root of the fourth power of 20736?
3— —— —— —— —— of 331776.
4— —— —— —— —— of 5308416.
5— —— —— —— —— of 84674656.
6— —— —— —— —— of 1354794496.
7— —— —— —— —— of 21676711936.
8— —— —— —— —— of 346827390976.
9— —— —— —— —— of 732846.2759.
10— —— —— —— —— of 67356.28.
11— —— —— —— —— of 473.69725.

THE ROOT OF THE FIFTH POWER.

WHEN the fourth power is multiplied by its root, it produces the fifth power, ſo 4×4×4×4×4=1024.

Wherefore 1024 is the fifth power of 4, and 4 is the root of the fifth power 1024.

RULE.

6=1296, theſe four numbers added together make 869616, which ſubtracted from the dividend leaves no remainder; wherefore, the work is finiſhed, and 36 is the true root, which may be proved by involving 36 to the fourth power.

If there be a remainder, you muſt take four ciphers for an additional period, and ſo on, till you have a ſufficient number of decimals in the root.

RULE.

Point your given power into periods of five figures each.

Find the greateſt root of the fifth power in the firſt period, which write in the root and the fifth power thereof, under the ſaid period, ſubtract it therefrom, to the remainder annex the next period for a dividend.

Multiply the fourth power of the root by 50000 for a diviſor. Aſk how oft the diviſor is contained in the dividend; write the anſwer in the root and multiply the diviſor thereby: multiply the ſquare of the laſt figure in the root by the cube of the reſt, and by 10000: multiply the cube of the laſt figure in the root by the ſquare of the reſt, and by 1000: multiply the fourth power of the laſt figure in the root by the reſt, and by 50. Involve the laſt figure in the root to the fifth power, add thoſe five numbers together and ſubtract their ſum from the dividend; to the remainder annex the next period for a new dividend, and repeat the operation till your work is finiſhed *.

EXAMPLES.

1—What is the fifth power of 16?

2—Extract the root of the fifth power of 248832.

3—Extract

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* EXAMPLE.—Extract the root of the fifth power of 33554432.

```
        33554432(32 root ſought.
        243
        -------
405000 )9254432
        -------
       81000000
        1080000
          72000
           2400
             32
        -------
        9254432
        -------
```

The greateſt root of the fifth power in 335 is 3, the fifth power of 3 is 243, which ſubtracted from 335 leaves 92, to which annex 54432 for a dividend. 3×3×3×3×50000=405000 for the diviſor. How oft 4050000 in 9254432. Anſwer 2 times; write 2 in the root, then 4050000=2=8100000 --2×2×3×3×3×10000=1080000, 2×2×2×3×3×10000=720000; 2×2×2×2×3×50=2400 2×2×2×2×2=32. The ſum of thoſe five numbers ſubtracted from the dividend leaves no remainder, wherefore 32 is the root ſought, as may be proved by involving 32 for the fifth power.

3—Extract the root of the fifth power of 7962624.
4— —— —— —— —— of 254803968.
5— —— —— —— —— of 8153726976.
6— —— —— —— —— of 260919263232.
7— —— —— —— —— of 4736.28746.

THE ROOT OF THE SIXTH POWER.

THE fifth power multiplied by its root, the cube by the ſquare or the ſquare by the cube will produce the ſixth power, ſo $4\times4\times4\times4\times4\times4=4096$. Whereſore 4096 is the ſixth power of 4, and 4 is the root of the ſixth power of 4096.

RULE.

Extract the ſquare root of the cube root, or the cube root of the ſquare root. Or,

Point your given number into periods of ſix figures each.

Find the greateſt root of the ſixth power in the firſt period, which write in the root and the ſixth power thereof under the ſaid period; ſubtract and annex the next period to the remainder for a dividend: multiply the fifth power of the root by 600000 for a diviſor. Aſk how oft the diviſor is contained in the dividend; write the anſwer in the root and multiply the diviſor thereby.

Multiply the ſquare of the laſt figure in the root by the fourth power of the reſt, and by 150000: multiply the cube of the laſt figure in the root, by the cube of the reſt, and by 20000: multiply the fourth power of the laſt figure by the ſquare of the reſt, and by 1500: multiply the fifth power of the laſt figure by the reſt, and by 60. involve the laſt figure to the ſixth power; add thoſe ſix numbers together and ſubtract their ſum from the dividend; to the remainder annex the next period for a new dividend. Repeat the operation till the work is finiſhed.

EXAMPLES *.

1—What is the ſixth power of 16?
2—What is the root of the ſixth power of 2985984?
3— —— —— —— —— of 191102976?
4— —— —— —— —— of 12230590464?
5— —— —— —— —— of 782757789696?

THE ROOT OF THE SEVENTH POWER.

IF the ſixth power be multiplied again by its root, it produces the ſeventh power, ſo 4×4×4×4×4×4×4 =16384. Wherefore 16384 is the ſeventh power of 4, and 4 is the root of the ſeventh power 16384.

RULE.

Point the given number into periods of ſeven figures each.

P Find

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* EXAMPLE.—What is the root of the ſixth power of 1544804416? The ſqare root of 1544804416 is 39304, and the cube root of 39304 is 34 the root ſought. Or,

```
          1544804416(34 root ſought.
           729
          ----------
145800000)815804416
          ----------
          583200000
          194400000
           34560000
            3456000
             184320
               4096
          ----------
          815804416
          ----------
              0
```

The greateſt root of the ſixth power in 1544 is 3, and the ſixth power of 3 is 729, which ſubtracted from 1544 leaves 815, to which 804416 being annexed makes 815804416 for a dividend; 3×3×3×3×3×600000=145800000 the diviſor; then 145800000×4 =583200000

4×4×3×3×3×3×150000=194400000
4×4×4×3×3×3×20000=34560000
4×4×4×4×3×3×1500=3456000
4×4×4×4×4×3×60=184320
4×4×4×4×4×4=4096——which ſix numbers added together, and the ſum ſubtracted from the dividend, leaves no remainder; wherefore 34 is the true root.

Find the greateſt root of the ſeventh power in the firſt period, which write in the root, and the ſeventh power thereof, under the ſaid period; ſubtract and annex the next period to the remainder for a dividend.

Multiply the ſixth power of the root by 7000000 for a diviſor. Aſk how oft the diviſor is contained in the dividend; write the anſwer in the root and multiply the diviſor thereby: multiply the ſquare of the laſt figure in the root by the fifth power of the reſt, and by 2100000: multiply the cube of the laſt figure by the fourth power of the reſt, and by 350000: multiply the fourth power of the laſt figure by the cube of the reſt, and by 35000: multiply the fifth power of the laſt figure by the ſquare of the reſt, and by 2100: multiply the ſixth power of the laſt figure by the reſt, and by 70: Involve the laſt figure to the ſeventh power. The ſum of thoſe ſeven numbers ſubtracted from the dividend, and the next period annexed to the remainder will be a new dividend with which proceed as before, thus repeat the operation till your work is finiſhed *.

1—What

---

* Example.—What is the root of the ſeventh power of 52523350144.

	52523350144(34
3×3×3×3×3×3×3 =	2187
3×3×3×3×3×3×7000000=	5103000000)30653350144
5103000000×4=	20412000000
4×4×3×3×3×3×3×2100000=	8164800000
4×4×4×3×3×3×3×350000=	1814400000
4×4×4×4×3×3×3×35000=	241920000
4×4×4×4×4×3×3×2100=	19353600
4×4×4×4×4×4×3×70=	860160
4×4×4×4×4×4×4=	16384
	30653350144

It is

EXAMPLES.

1—What is the ſeventh power of 16?
2—Extract the root of the ſeventh power of 35831808.
3— —— —— —— of 4586471424.
4— —— —— —— of 587068342272.
5— —— —— —— of 75144747811816.
6— —— —— —— of 9618527719912448.

SOME USES OF THE SQUARE ROOT.

THE ſquare root of the product of any two numbers, is a geomatrical mean proportion between them.

It is difficult to ſhew from whence the rules for the extraction of roots is derived, without the aſſiſtance of algebra.

$$\begin{array}{lcll}
20+4 & = & 24 & \\
20+4 & & 24 & \\
\hline
400+80 & & 96 & \\
\quad 80+16 & & 48 & \\
\hline
400+160+16 & = & 576 & =\text{ſquare of } 24. \\
20+4 & & & \\
\hline
800+3200+320 & & & \\
\quad 1600+640+64 & & & \\
\hline
8000+4800+960+64 & = & 13824 & =\text{cube of } 24.
\end{array}$$

Here it may be obſerved, that the ſquare of any number conſiſting of two figures, is compoſed of 100 times the ſquare of the tens figure, twenty times the product of the two figures, and the ſquare of the units figure; and the cube conſiſts of 1000 times the cube of the tens figure, 300 times the ſquare of the tens figure multiplied by the units figure, 30 times the tens figure multiplied by the ſquare of the units figure, and the cube of the units figure—From whence the rules for extracting thoſe roots are derived—and by the ſame manner of proceeding, all the others are deduced.

EXAMPLES.

1—Required a geomatrical mean proportion between 16 and 64.

To divide a number into extreme and mean proportion, that is to divide it into two ſuch parts, that the ſquare of one part may equal the product of the other and the whole.

Multiply the ſquare of the given number by $1\frac{1}{4}$ or $\frac{5}{4}$, from the ſquare root of the product ſubtract half the given number, the remainder will be the greater part, which ſubtracted from the whole given number leaves the leſs.

EXAMPLE.

2—Divide 32 into extreme and mean proportion.

The areas of ſimilar ſuperficial figures are to one another, as the ſquares of their like dimenſions; wherefore, the ſquare of the diameter of any circle, is to its area; as the ſquare of the diameter of any other circle to its area: and the ſquare of the circumference of any circle is to its area, as the ſquare of the circumference of any other circle, to its area: alſo as the ſquare of the ſide of any polygon to its area, ſo is the ſquare of the ſide of any ſimilar polygon to, its area.

EXAMPLES.

3—If the diameter of a circle be 1, its area will be .7854; but if the diameter of another circle be 11.3, what is its area?

4—If the circumference of a circle be 1, its area will be .07958; but if the circumference of a circle be 35.5, what is its area?

5—If the ſide of a regular hexagon be 2, its area will be 10.3923; but if the ſide of another regular hexagon be 7.7, what is its area?

The ſquare of the ſide of a ſquare is the area of that ſquare; therefore the ſquare root of the area of a ſquare is the ſide, or the ſquare root of any given area is the ſide of a ſquare equal in area.

EXAMPLES.

6—If the area of a ſquare be 1152; what is its ſide?
7—If the area of a circle be 1296; what muſt be the ſide of a ſquare to contain the ſame meaſure?

The ſquare root of the number of men to be formed into a ſquare, is the number in rank and file, that is the number on each ſide.

EXAMPLE.

8—576 men are to be formed into a ſquare, how many muſt be in rank and file?

In any right angled triangle, the ſquare of the hypothenuſe, or longeſt ſide, is equal to the ſum of the ſquares of the other two ſides, or baſe and perpendicular; therefore the difference of the ſquares, of the hypothenuſe and a ſide, is the ſquare of the third ſide: therefore, the ſquare root of the ſum of the ſquares of the baſe and perpendicular, is the length of the hypothenuſe; and the ſquare root of the difference of the ſquares of the hypothenuſe and another ſide, will be the third ſide.

EXAMPLE.

9—If the baſe of a rectangled triangle be 16 and the perpendicular 9; what is the length of the hypothenuſe or longeſt ſide?
10—If the hypothenuſe of a rectangled triangle be 25 and the baſe 20; what is the length of the perpendicular?
11—If the hypothenuſe of a rectangled triangle be 20, and the perpendicular 12, what is the length of the baſe?

The velocities of heavy bodies acquired by falling, are directly as the times, for as any given time, to the velocity at the end of that time; ſo is any other given time, to the velocity at the end of that time; wherefore the diſtances fallen through are to one another as the

ſquares

ſquares of the times directly, viz. as the ſquare of any given time to the diſtance fallen through in that time, ſo is the ſquare of any other given time to the diſtance fallen through in that time.

Example.

12—If a heavy body fall freely through a ſpace of 16 feet 1 inch in the firſt ſecond, how far would it fall in 7½ ſeconds?

The lengths of pendulums are to one another inverſely, as the ſquares of the number of their vibrations made in the ſame time, viz. as the ſquare of the number of vibrations made by one pendulum in a given time, to its length; ſo is the ſquare of the number of vibrations made by another pendulum in the ſame time inverſely, to its length.

Examples.

13—If a pendulum 39.2 inches long, make 60 vibrations, or ſwings, in a minute; what length muſt another pendulum be to make juſt 140 ſwings in a minute?

14—Divide 64 into extreme and mean proportion?

15—Required a geometrical mean proportion between 32 and 48?

16—If the diameter of a circle be 1, its area will be .7854, but if the area of a circle be 100.29; what is the length of its diameter?

17—If the area of a ſquare be 1296; what is the length of each ſide?

18—If 7744 men be formed into a ſquare, how many will be on each ſide?

18—If the baſe of a rectangled triangle be 28, and the perpendicular 21; what is the length of the hypothenuſe?

20—If the area of a circle be 426, what is the ſide of a ſquare containing the ſame meaſure?

21—If the diameter of a circle be 1, its area, will be .7854; but if the area of a circle be 401.6; what is the length of its diameter?

22—If the hypothenuſe of a rectangled triangle be 34, and the perpendicular 18; what is the length of its baſe?

23—If a ladder 32 feet long will juſt reach to the top of a wall when ſtanding at 12 feet diſtance from the foot thereof; what is the hight of the wall?

24—A pendulum 39.2 inches long, will make 60 ſwings in a minute; how many ſwings will a pendulum make in a minute, which is 52 inches long?

25—How far will a heavy body fall in $3\frac{1}{2}$ ſeconds ſuppoſing it to fall $16\frac{1}{12}$ feet the firſt ſecond?

26—Suppoſe a tower to be 48 yards high; how long would a ſtone be in falling from the top thereof, to the ground, allowing it to fall 16 feet the firſt ſecond of time?

27—Two men bought a grinding ſtone 42 inches in diameter which coſt 14s. the firſt paid 8s. and the other 6s. and they agreed that the firſt ſhould have the uſe of it till his ſhare was worn down; what muſt be its diameter when the latter receives it?

SOME USES OF THE CUBE ROOT.

THE capacities or contents of ſimilar ſolids are to one another as the cubes of their like dimenſions; wherefore the contents of globes are to one another as the cubes of their diameters, or as the cubes of their circumferences; and ſo are hemiſpheres, or any like portions of globes.

The contents of any of the five regular bodies are to one another as the cubes of their like ſides.

The quantities of powder or ball ſufficient to charge different guns, are to one another as the cubes of the diameters of thoſe guns.

The burthens of ſhips which are built in the ſame proportion, are to one another as the cubes of their lengths, or of any their like dimenſions.

EXAMPLE.

1—If the diameter of a globe be 1, its contents will be .5236. but if the diameter of a globe be 7.5, what is its content?

2—If the diameter of a globe be 1, its content will be .5236, but if the content of a globe be 1728, what is its diameter?

3—If $\frac{1}{4}$lb. of gunpowder be ſufficient to charge a gun of $1\frac{1}{4}$ inches bore, how much will charge a gun of $2\frac{3}{4}$ inches bore?

LOGARITMICAL ARITHMETIC.

LOGARITHMS are artificial numbers, ſo contrived as to perform multiplication by addition, diviſion by ſubtraction; raiſing of powers by multiplication; extraction of roots by diviſion.

To find the logarithm to any given number.

The logarithm of 1 is 0.0000, of 10 is 1.00000, of 100 is 2.00000 of 1000 is 3.00000, &c.

The index or whole number prefixed to logarithms denotes the number of figures in the integral part of the natural number, or the power of 10 contained therein; therefore it is always one leſs than the number of figures in the natural numbers omitting the decimals, ſo that for any number leſs than 10 the index is 0: for any number leſs than 1, if the tenths be a figure of any value, the index may be 9, with 10 to be ſubtracted, or 1 leſs than 0; if the tenths figure be a cipher, the index may be 8 with 10 to be ſubtracted, or 2 leſs than 0; and ſo on, decreaſing 1 as the value of the natural number is diminiſhed by a diviſion by 10. The index is omitted in moſt logarithmical tables, to be ſupplied by the practitioner according to the foregoing directions.

The logarithm of a vulgar fraction is had by ſubtracting the logarithm of the denominator from the logarithm of the numerator; the remainder is the logarithm of the fraction.

To find the natural number correſponding to a given logarithm.

Find the logarithm in the table without regard to the index, and write out the natural number thereto, and place the decimal point ſo, that the whole number may have one place of figures more than the index.

EXAMPLES.

1—What is the logarithm for 2704?
2— —— —— —— 27.04?
3— —— —— —— 270.4?
4— —— —— —— 27.046?
5— —— —— —— 2.704?
6— —— —— —— .27045?
7— —— —— —— .027?
8— —— —— —— .0027?
9— —— —— —— .00027?
10—What is the logarithm of 73.465?

MULTIPLICATION
BY LOGARITHMS.

ADD the logarithm of the two factors together, the ſum will be the logarithm of the product.

EXAMPLES.

1—Multiply 247 by 36.
2—Multiply 24.6 by 17.5.
3—Multiply 2.48 by 3.65.
4—Multiply 1.736 by .235.
5—Multiply .736 by .45.
6—Multiply .284 by .076.
7—Multiply .0365 by .042.

DIVISION BY LOGARITHMS.

SUBTRACT the logarithm of the diviſor from the logarithm of the dividend, the remainder is the logarithm of the quotient.

EXAMPLES.

1—Divide 304 by 16.
2—Divide 748 by 217.
3—Divide 217 by 748.

RULE OF THREE, &c.
BY LOGARITHMS.

ADD the logarithms of all the factors together, from the ſum ſubtract the logarithm of the diviſor, or the ſum of the logarithms of the diviſors; (if there be more than one) the remainder will be the logarithm of the anſwer.

EXAMPLES.

1—If 14 produce 23, what will 42 produce?
2—If 27 yards of cloth coſt 3.75l., what will 126 yards coſt?

INVOLUTION OR RAISING OF POWERS BY LOGARITHMS.

MULTIPLY the logarithm of the given number by the index of the power, that is, by 2 for the ſquare or ſecond power, by 3 for the cube or third power, by 4 for the fourth power, &c. the product will be the logarithm of the required power.

EXAMPLES.

1—What is the ſquare of 27?
2—What is the cube of 16?
3—What is the fourth power of 9?
4—What is the fifth power of 18?
5—What is the ſquare of 27.4?
6—What is the cube of 3.25?
7—What is the fourth power of 2.84?
8—What is the ſixth power of .375?
9—What is the eighth power of .0364?

EVOLUTION

EVOLUTION OR EXTRACTION OF ROOTS BY LOGARITHMS.

DIVIDE the logarithm of the given number or power by the index of the root, that is, by 2 for the ſquare root, by 3 for the cube root, by 4 for the root of the fourth power, &c. the quotient will be the logarithm of the required root.

EXAMPLES.

1—What is the ſquare root of 576?
2—What is the ſquare root of 57.84?
3—What is the cube root of 13824?
4—What is the root of the fourth power of 7364?

DUPLICATE PROPORTION
BY LOGARITMS.

WHEN the firſt term bears the ſame proportion to the ſquare of the ſecond, as the third bears to the ſquare of the anſwer: Or,

When the ſquare of the firſt bears the ſame proportion to the ſecond, which the ſquare of the third bears to the anſwer.

For numbers to be ſquared take double their logarithms; and where a root is to be extracted take half the logarithm—the reſt of the work is by adding and ſubtracting as in common proportion.

For cubic proportion, take three times the logarithm of the numbers to be cubed, and a third part of the logarithm where the cube root is required, and ſo for any higher power or root.

EXAMPLES.

1—If a pendulum 39.2 inches long make 60 ſwings in a minute, what muſt be the length of a pendulum to make 40 ſwings in a minute?

2—If the diameter of a circle be 2 its area will be 3.1416; what is the area of a circle whoſe diameter is 11.5?

3—If a cannon ball which is 2.5 inches in diameter weigh 2 lbs.; what will be the weight of another ball of the ſame metal whoſe diameter is 4¼ inches?

THE USE OF THE SLIDING RULE.

THE lines on the ſliding rule are logarithmic diviſions; the numbers being placed to the diviſions which correſpond with the logarithms of thoſe numbers; ſo that twice the diſtance of any number from 1 is twice the logarithm of that number, and therefore is the place of the ſquare of that number; and the ſum of the diſtances of two numbers from 1 is the ſum of their logarithms, and therefore is the logarithm of the product, and ſo on.

The lines A and B are two equally divided lines, from 1 to 10 and from 10 to 100, which ſlide one againſt the other, by which multiplication, diviſion, and ſimple proportion are worked.

MULTIPLICATION BY THE SLIDING RULE.

AS 1 to one of the factors, ſo is the other factor to the product; therefore, ſet 1 on A to one factor on B, then againſt the other factor on A, you will have the product on B: or, which is the ſame thing, ſet 1 on B to one factor on A, then againſt the other factor on B, you will have the product on A.

EXAMPLES.

1—Multiply 37 by 6.
2—Multiply 16 by 8.
3—Multiply 7 by 4.

DIVISION BY THE SLIDING RULE.

As the diviſor to the dividend, ſo is 1 to the quotient; therefore, ſet the diviſor on A to the dividend on B; then againſt 1 on A you will have the quotient on B.

Or, ſet the diviſor on B to the dividend on A; then againſt 1 on B, you will have the quotient on A.

EXAMPLES.

1—Divide 284 by 6.
2—Divide 96 by 12.
3—Divide 746 by 8.5.
4—Divide 37.5 by 62.
5—Divide 374.25 by 3.68.

RULE OF THREE

BY THE SLIDING RULE.

SET the firſt term or diviſor on A, to one of the other numbers on B; then againſt the third on A, will ſtand the fourth, or anſwer on B. Or,

Set the firſt term on B, to the ſecond on A; then againſt the third on B, will ſtand the fourth, or anſwer on A.

EXAMPLES.

1—If 6 give 9, what will 48 give?
2—If 74.5 give 3.64, what will 384 give?
3—If 7 yards of cloth coſt 24 ſhillings, what will 34.5 yards coſt?
4—How many men will do as much work in 14 days as 8 men will perform in 42 days?
5—What is the value of 46 cwt. when $\frac{3}{4}$ cwt. coſt 2.75l.?
6—If a cylindric veſſel be filled to 4.3 inches of its depth with 8 gallons of ale, how many gallons are therein when it is filled to 14.7 inches deep?
7—If a board which is 9 inches broad and 6 feet long meaſure 6 ſquare feet, what is the meaſure of a board the ſame breadth and 16½ feet in length?

OF THE SQUARE ROOT
BY THE SLIDING RULE.

ON this face of the ſliding rule, the ſlider is divided as the lines A and B on the other face, and is commonly marked C. But the line D, on the rule has its diviſions twice as large as thoſe on C; viz. The numbers are written to the double logarithm of the ſame diviſions; wherefore they repreſent their ſquares.

To ſquare any number by the ſliding rule,—Set 1 on C to 1 on D; then againſt any number on D, ſtands the ſquare thereof on C.

Or, ſet 1 on A, to any number on B; then againſt the ſame number on A, will ſtand the ſquare thereof on B.

Set any number on C, to 1 on D; then againſt the ſame number on D, you'll find its cube on C.

EXAMPLES.

1—What is the ſquare of 4?
2—What is the ſquare of 16?
3—What is the ſquare of 7.5?
4—What is the ſquare of 1.5129?
5—What is the cube of 4?
6—What is the cube of 16?
7—What is the cube of 7.5?
8—What is the ſquare of 237?

TO EXTRACT THE SQUARE ROOT.

SET 1 on C, to 1 on D; then againſt any number on C, is the ſquare root thereof on D.

Or by the lines A B.

Move the ſlider till 1 on A, ſtand againſt the ſame number on B, which the given number on B, ſtands againſt on A, that number will be the ſquare root.

TO EXTRACT THE CUBE ROOT.

MOVE the ſlider till the ſame number thereon ſtand againſt 1 on D, which the given number on C ſtands againſt on D, that number will be the cube root of the given number.

EXAMPLES.

1—What is the ſquare root of 16?
2—What is the ſquare root of 256?
3—What is the ſquare root of 56.25?
4—What is the ſquare root of 2.2888?
5—What is the cube root of 64?
6—What is the cube root of 421.875?
7—What is the ſquare root of 56169?

OF DUPLICATE PROPORTION
BY THE SLIDING RULE.

WHEN the firſt term bears ſuch proportion to the ſquare of the ſecond, as the third bears to the ſquare of the fourth—

Set the firſt on C to the ſecond on D, then againſt the third on C, you'll find the fourth on D.

This is multiplying one number by the ſquare of another, dividing the product by a third, and extracting the ſquare root of the quotient by one ſlip or ſet of the ſlider.

EXAMPLES.

1—If 6 give the ſquare of 4, what number will 9 give the ſquare of?
2—If the diameter of a circle be 1 its area will be .7854; but if the area of a circle be 201.25, what is its diameter?
3—If a pendulum 39.2 inches long make 60 ſwings in a minute, how many ſwings will a pendulum 42 inches long make in a minute?

4—If a circular veſſel 16 inches diameter contain .713 gallons of ale at 1 inch deep; what muſt the diameter be to contain 3.5 gallons at 1 inch deep?

When the ſquare of the firſt bears the ſame proportion to the ſecond, which the ſquare of the third bears to the fourth,—

Set the firſt on D to the ſecond on C, then againſt the third on D you'll find the fourth on C.

This is ſquaring a given number, multiplying by another, and dividing by the ſquare of a third at one ſet of the ſliding rule.

EXAMPLES.

1—If the ſquare of 4 give 6, what will the ſquare of 4.897 give?

2—If the diameter of a circle be 1, its area will be .7854; but if the diameter of a circle be 11.3, what will its area be?

3—If a pendulum 39.2 inches long make 60 vibrations in a minute, what muſt be the length of a pendulum which makes 40 vibrations in a minute?

4—If a circular veſſel 32 inches in diameter contain 2.85 ale gallons at 1 inch in depth, what will a veſſel contain at 1 inch in depth, which is 42 inches in diameter?

Miſcellaneous

Miscellaneous Questions.

1—What is the thirty-fourth part of ſeventeen times 48?

2—What is the difference between $\frac{2}{3}$ of $\frac{5}{9}$, and $\frac{1}{4}$ of $\frac{2}{3}$ of $1\frac{4}{5}$?

3—What number divided by 56, will give $13\frac{1}{2}$ in the quotient?

4—If $1\frac{1}{2}$ yards of kerſey coſt 3s. how many yards of the ſame may I have for a guinea?

5—What will $46\frac{3}{4}$ yards come to at 1l. 17s. 9d. per yd.?

6—How far will a man travel in 46 days, who travels 240 miles in 8 days?

7—If 6 men do a piece of work in 8 days, how many men would do the ſame in 3 days?

8—How many yards of flannel at 15d. per yard will purchaſe ſix dozen of wine at 1s. $8\frac{1}{2}$d. per bottle?

9—Sold cloth at 7s. 4d. per yard and gained 12 per cent.; what would have been my gain per cent. if I had ſold the ſame at 8s. per yard?

10—If two men do a piece of work in 8 days, which one of them would perform in 12 days; in what time would the other do it himſelf?

11—Required the value of $\frac{4}{5}$ of $\frac{7}{8}$ of 13s. 4d.?

12—What is the value of $\frac{2}{3}$ of $\frac{7}{9}$ of 16 feet?

13—If $\frac{2}{7}$ of a noble buy $\frac{5}{9}$ of an ell engliſh, how many yards will $7\frac{3}{4}$ guineas buy?

14—Required the value of 125 oz. 17 dwts. 23 grs. of ſilver at 5s. 11d. per ounce?

15—A grocer bought 96 lbs. of tea for 38l.; how muſt he ſell it per ounce to gain 12l. at laying out 80l.?

16—A perſon after ſpending two thirds of his money at one place, and half the remainder at another, had 32 guineas left; how much had he at firſt?

17—Sold a quantity of Virginian ſnake root for 20l. and by ſo doing loſt 20 per cent., whereas I ought to have gained as much per cent. as the ſnake root coſt me; what was my loſs in point of trade?

18—A, B and C bought a piece of land, which they paid for in ſuch manner, that as oft as A paid 8l. B paid 6l., and as oft as A paid 5l. C paid 7l.—required each perſon's ſhare of the yearly rent which is 160l.?

19—A perſon left by will 200l. to his two ſons, to be paid in the following manner, viz. to the oldeſt 1l. the firſt month, 3l. the ſecond month, 5l. the third, and ſo on, in arithmetical progreſſion; but the younger was to receive 10l. per month till the whole was paid; how much was each ſon's ſhare, and how long will they be in receiving it?

20—The heighth, breadth and length of a room are 4, 6, and 9 yards reſpectively; what is the longeſt right line that can be taken within that room?

21—A plumb or weight of 20 lbs. hung at 30 inches diſtance from the fulcrum of a ſteel yard, will counterpoiſe a caſk of red wine ſuſpended at 2 inches from the fulcrum on the other ſide; how many gallons of wine does the caſk contain, ſuppoſing a gallon to weigh $7\frac{1}{2}$ lb. and the wood to weigh 40 lbs.?

Note—The weights to keep a lever or ſteel yard in equilibrio, will be inverſely as their diſtances from the fulcrum.

22—Bought 4768 yards of cloth for 1192l. which I ſold at 7s. 6d. per ell Engliſh; what did I gain thereby, and what per cent.?

23—A perſon borrowed 400l. and agreed to pay 50l. yearly for 10 years; whether will he gain or loſe thereby, reckoning compound intereſt at 5 per cent. per annum?

24—A perſon bought 300 eggs at 2 for a penny, and 300 at 3 for a penny, and afterwards ſold the whole at 5 for two-pence; whether did he gain or loſe thereby, and how much?

25—A perſon bought 1000 apples at 5 for a penny, and ſold one half thereof at 4 for a penny, and the other half at 6 for a penny; what did he gain or loſe thereby?

26—Sold hops at 6l. 15s. per cwt. and gained 20 per cent.; what would have been the gain per cent. if they had been ſold for 7l. 5s. per cwt.?

27—A perſon laid out 60l. in cloth at 5s. per yard, and 60l. in another parcel at 6s. per yard, all which he ſold at 5s. 6d. per yard; what did he gain or loſe thereby, and what per cent.?

28—If I take half of a number and half of the remainder continually, what will be the ſeries, and the ſum thereof in infinitum?

29—If I take two thirds of any given number, and two thirds of the remainder continually, what will be the form of the ſeries, and the ſum thereof in infinitum?

30—Take three fourths of any number, and three fourths of the remainder continually, and ſhew the form of the ſeries, and the method of finding the ſum thereof in infinitum.

31—If I take four fifths of any number, and four fifths of the remainder continually, what is the form of the ſeries and the ſum thereof?

32—Bought a horſe and ſold him again for 50l. and gained one fourth of what he coſt me; what was the coſt and gain?

33—Sold a horſe for 30l. and gained 20 per cent.; what did he coſt me?

34—What number is that, if two ſevenths thereof be multiplied by 3, the ſquare root of two ninths of the product will be 4?

35—The longeſt right line that can be taken in a room whoſe length, breadth and height are all equal is 7 yards; what is the length, breadth and height of that room?

36—A gentleman has an eſtate with forty cottages thereon, which he values in the following manner—the firſt at 1s. the ſecond at 2s. the third at 4s. and ſo on, doubling through the whole; what does he value the laſt at, and what would be the purchaſe of the whole?

37—If the diameter of a circular buſhel be 18.5 inches, what muſt be the diameter of a two buſhels meaſure, of the ſame depth with the former?

39—If a ſhip of 300 tons burthen be 40 feet long at the keel, what length of keel muſt a ſhip of 800 tons have?

40—A ladder ſtanding upright againſt a wall juſt reaches the top thereof, but ſtanding 12 feet from the bottom, will reach to within 6 feet of the top; what is the height of the wall, or length of the ladder?

41—If a ſtone be 3½ ſeconds in falling from the top to the bottom of a coal pit, what is the depth of the pit?

42—Sound is ſaid to fly uniformly at the rate of 1142 feet per ſecond: now if ſeven ſeconds elapſe betwixt ſeeing the fire and hearing the report of a gun, at what diſtance is the ſpectator from the gun?

43—How far diſtant is thunder, when 9¾ ſeconds elapſe between ſeeing the flaſh of lightning and hearing the thunder?

44—What muſt be the diameter of a circular meadow to contain juſt an acre, or 4840 ſquare yards?

45—Suppoſe a wall be 30 feet high, and a ladder 30 feet long ſtand 9 feet from the foot of the wall; how far will the top of the ladder be from reaching to the top of the wall?

46—There are two cannon balls, one of which weighs 28 lb., and the other 9 lb., the leſſer ball is 5 inches in diameter; what is the diameter of the greater?

47—If $\frac{2}{3}$ of 7 be made 4, what will $\frac{1}{6}$th of 16 be made?

48—Write ſix ſevens ſo as to make 78.

49—Three men, A, B and C, have each a certain ſum of money; now A's and B's together is 60l., B's and C's 84l., and A's and C's 72l.; how much had each?

50—How long muſt an annuity of 25l. 10s. per annum be continued to diſcharge a debt of 250l., allowing compound intereſt at 5 per cent.?

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